# THE · JOURNAL · OF · THE AMERICAN · SOCIETY · OF MECHANICAL · ENGINEERS

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# THE JOURNAL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

## JANUARY, 1918


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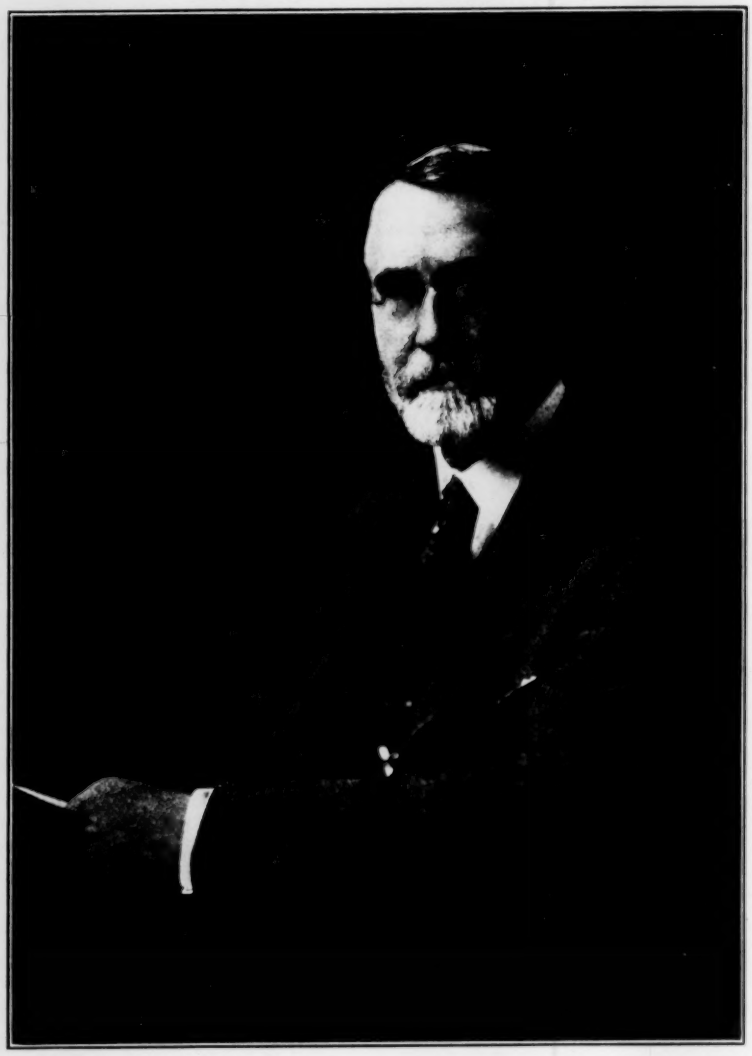

CHARLES THOMAS MAIN

PRESIDENT 1918

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE JOURNAL OF

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Volume 40 January 1918 Number 1

# THE ANNUAL MEETING

SOME of the general meetings of the Society have excelled in the number of members and guests in attendance, some in the notable speakers and papers, some in the activity of the discussions, some in the timeliness of the topics on the program, some in the distinguished receptions held by the Society and some in the signal advances in the Society's policies; but the 38th Annual Meeting held in the Engineering Societies Building from December 4 to 7, 1917, will go down in the annals of the Society as having excelled in all of these, and in one other—the outspoken patriotism evoked by the nation's crisis in which engineers are playing no small part.

The note of patriotism sent forth by Dr. Ira N. Hollis, President of the Society for 1917, at the opening session was echoed again and again throughout the meeting and imparted to the entire proceedings the nature of a War Convention, which is likely to have a far-reaching effect upon the relations of the engineer to the Government in this emergency.

## Opening Session

At the beginning of the session on Tuesday evening, President Hollis said it had been decided to omit the regular presidential address in order that there might be time to listen to one who had been honored by this nation, Hon. William H. Taft, Ex-President of the United States; and to confer Honorary Membership on one who had constructed the greatest engineering work on earth, Major-General George W. Goethals. Continuing, Dr. Hollis said:

"The Committee on Meetings decided in the late summer to change the character of our convention this year on account of the exceptional conditions in which we find ourselves. It is our first annual meeting held during a war in which we are participants. Many of our members have gone already, and many are going to voluntary service in the earnest hope of making themselves useful to their country. Three of the Council are officers in the army: Major John H. Barr, Major William B. Gregory and Major Max Toltz; and others are serving well in civilian capacities. So much time is given by the engineers to invention, research, and manufacture for war purposes, that we could not, if we wished, conduct the usual technical program. Thus, by force of circumstances, as well as by the cheerful acquiescence of the Council and members, we turn our thoughts to public service and to discussion that will help us to see our way more clearly through this black calamity that has overtaken all the world.

"As American citizens, we hold our country to be the asylum for the oppressed, the home of opportunity for the lowly, and the land of faith in honor, truth and justice among nations, as well as among individuals.

"As engineers, our creed knows no compromise between might and right. It knows no pacifism that requires us to turn the other cheek to the assassin of all that humanity has held dear. The right to live was given to us by the Almighty, and we believe that 'they who take the sword shall perish with the sword.' Unhappily, all who are led by them share the same fate. We also believe in the justice of that penalty. We now hold the sword of the Lord and of Gideon in our hands, to use with all our strength against the barbarians of this twentieth century, so that science may be made safe for all mankind. And we have

"'Never doubted clouds would break,
Never dreamed, though right were worsted, wrong would triumph.'

"We have asked one who has held the highest office in this country, and another who has completed the greatest engineering feat on earth, to assist us in giving ourselves anew to the service of our country; but I should fail my purpose if I did not call attention to one aspect of the war.

"What are we to get out of this war? Not land, not booty, not empire, for we have disclaimed all these. We have gone in for humanity, making the great sacrifice of ourselves in the hope that the next generation may find itself the better for our share in this struggle. Our resources will be wasted on the unessentials of civilization; the blood of our young men will be shed on many battlefields, and our old people will spend their declining years in sorrow, some even in misery, as a consequence of our participation in this war. What, then, are we to get out of it?

"When we stop to think of the willingness with which thousands of men and women are working under hard conditions to train themselves for war, we find a new dignity in labor, and we gather from it a new force that can be made to supply the solvent of future struggles between capital and labor. There are many employers serving now on the battle line and many more employees serving under them, where the hardships and the deadly routine are infinitely greater than in any of the old industries. Yet the suspicions and the bitter antagonisms are gone. The relation between a good commander and his soldiers is exactly what we should have between employer and employee. Those who have been involved in a



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common risk and a common service in face of death, will find a new conception of industrialism after the war is over.

"Can the virtues of war, the comradeship of the battlefield, not be made to survive in the peace that will come some day? Is it not possible to learn from this struggle that the age-long war between employer and employee never was necessary and never should have existed? Is it not possible to learn that all mankind are involved in a common fate made happier and better by mutual understanding and mutual service? Is it not possible to learn further that the power of wealth can be enjoyed only through the use to which it is put? If not, our country is sentenced to militarism for generations to come, and democracy will never be safe for any nation.

"I have been struck by a description that should stand to us as the pattern by which we may well hope to plan our lives. It is that of The Beloved Captain in one of the war books, whose career on the battle front carries a lesson to all who are leaders of other men.

'He came in the early days when we were still at recruit drills. Tall, erect, smiling, so we first saw him, and so he remained to the end. He had a smile for almost everyone, but we thought he had a different smile for us. We looked for it, and we were never disappointed. It meant that we were his men and that he was proud of us and sure that we were going to do well, and it made us determined that we would. No trouble of ours was too small for him to attend to. When we started route marches, for instance, and our feet were blistered and sore, as they often were at first, you would have thought that they were his own feet, from the trouble he took. He came into our rooms and if anyone had a sore foot, he would kneel down on the floor and look at it as carefully as if he had been a doctor. Then he would prescribe, and the remedies were ready at hand, being borne by the sergeant. There was no affectation about this, no striving after effect. It was simply that he felt that our feet were important and that he knew that we were pretty careless. Nevertheless, there was, in our eyes, something almost religious about this care for our feet. It seemed to have the touch of Christ about it and we loved and honored him the more. We knew that we should lose him, and so it proved. If ever there were a moment of danger, he was on the spot. No one would shirk if he were there. There was not one of us but would gladly have died for him. One day a torpedo fell into the trench and buried some of our chaps. The fellows next to them ran to dig them out. Of course, he was one of the first; and then came another torpedo in the same place. That was the end.

'Somehow he lives, and we who knew him do not forget. We feel his eyes are on us. We still work for that wonderful smile of his. There are not many of the old lot left now, but I think that those who "went West" have seen him. When they got to the other side, I think they were met. Some one said, "Well done, good and faithful servant," and, as they kneeled before that gracious, pierced Figure, I reckon they saw nearby the captain's smile. Anyway, in that faith let me die, if death should come my way, and so I think I shall die content.'

"Donald Hankey, who wrote that, had his wish. He joined his beloved captain when he was killed on the western front October 26, 1916.

"The best that we have survives in such memories. They are worth all the triumphs in politics, business and war. The finest measure of George Washington's greatness is not found in the surrender of Cornwallis, but in the tears of his officers when he gave up the command of the American Army. And Abraham Lincoln will last through the centuries, not as the President of a triumphant Union, but as the man who freed the slaves, and who in one short speech at Gettysburg dedicated this nation for all time to the freedom and brotherhood of man. The noble gentleman who is sitting here on the stage with us will be remembered by our children not on account of his great acts while President, but for the faith and love his gentle, generous kindness have inspired in the heart of every American citizen.

"Is there any man in this room who does not envy the beloved captain? There are few employers in America who would not exchange places with him, who would not willingly trade that memory for a thousand victories in the strikes that have wasted energies. There are few men in the unions who would not surrender to an employer like that. The poorest inheritance of the war will be material gain and the pride that glories in greater wealth and greater power. Its most precious heritage will be the memories that teach the value of work well done in behalf of those in our command. That I believe to be fundamentally the faith of the American engineer, and that I hope may become the practical ideal of every captain of industry. There are many such men in America, and if this war only reveals them to us, we may find some compensation for the lives that we must give.

"We all know men who are, under the right conditions, capable of becoming beloved captains. In their unselfish modesty we sometimes forget the qualities they possess, and the power of expressing to them our understanding is often denied us.

### INTRODUCTION OF THE PRESIDENT-ELECT

At the conclusion of these remarks, Dr. Hollis introduced to the membership President-Elect Charles T. Main, who was then escorted to the platform. In presenting him to the audience Dr. Hollis said:

"Happily, my opportunity has come tonight in presenting to this company one who in another year will be known to our whole family, as he is already known and understood by a few of us. I could not have hoped for a better fate than to have my year of service buttressed up by two such men as the quiet, unassuming gentleman who preceded me in office, and the next President of The American Society of Mechanical Engineers, Charles T. Main."

In acknowledging the introduction, the President-Elect thanked the members of the Society for conferring upon him such a great honor of leading the Society through a period of great effort and responsibility. He continued:

"During the past year, under the leadership of our beloved captain, many things have been accomplished, but far less than he has wished could have been done. I shall endeavor to maintain and uphold the traditions of our Society and to carry on his good work, but nothing worthy of mention will be accomplished without the support of the whole membership. The work of one man, or the life of one man, is a mere drop in the bucket in the great work which we have to do for the cause of humanity.

"The record of the engineering profession and the work which it has done in the past year is worthy of mention, but I feel that we have hardly begun to bear the full measure of the work which we should do, and I trust that in the next year we may do something which is commensurate with our responsibilities.

"This is not a time to discuss future policies, and it would be impossible to do so owing to the rapidly changing conditions. But there is, however, one ruling and central motive which every member of this Society and every citizen of this country should set up, the concentration of intellect, strength, resources and life, if necessary, to a satisfactory ending of this great war."

### HONORARY MEMBERSHIP FOR GENERAL GOETHALS

Following the introduction of Mr. Main was the conferring of Honorary Membership upon Major-General George W. Goethals. In presenting Major-General Goethals Dr. Hollis very happily recalled a little personal incident:

"A few years ago I spent a week on the Isthmus with our newest member. He had as butler a conglomerate wreck of all the Latin races, named Benoit. Whatever happened to the organization of the Canal, Benoit went with the house of the commanding officer. He held his office against all comers by means of a carving knife, and the Colonel could not discharge him. In fact, it lay between the two which would discharge the other. That was the one weakness of the Canal administration. I reveal this now lest you think him more than human.

"We who see him here know his stronger side, and we welcome him as a brother engineer in whose great accomplishment we take a pride. He belongs peculiarly to us, for his talents have been expended on the essentials of modern civilization rather than on the destructive elements of war.

"Honorary membership expresses for the members of our Society the highest gift we can bestow, and we give it to George W. Goethals in recognition of his great work as an engineer and of his fearless execution of duty in carrying the Panama Canal to its completion."

Major-General Goethals, in accepting the honor, said:

"Mr. President, Ladies and Gentlemen: It is generally believed that I built the Panama Canal. That is a mistake. The man who dug it claims to have built it, his successor in office claims to have built it, and I claim to have been one of fifty thousand men who built it. I learned exactly where I came in, in a trip that I took across the Canal in a Panama Railroad train, when a foreman describing the Canal to a visitor led the visitor to understand that he was doing pretty much all of it. The visitor finally turned to him and said, 'What is the old man, as you call him, doing?' The foreman replied, 'Oh, he comes around, and sees us doing it, jollies us a bit, and then goes back and sits in the office and entertains visitors.'

"Those of you who visited the Canal during the construction period must have appreciated the part performed by the mechanical engineers in the machinery that we used for the work, and must have appreciated the mechanical work done in the states in order that we might carry it forward. Those of you who have visited the Canal since its completion, and have seen the satisfactory working of the machinery of the locks, the dredging equipment used in the removal of the slides, and the various other appliances, must have appreciated the work of the mechanical engineers in the designing and construction of that machinery; and, realizing the assistance that they gave in the work, during its constructive period, and appreciating this assistance in its operative period, you may perhaps form some idea of the appreciation I have for the honor that this Society has conferred upon me, by electing me an honorary member, and I want to thank you heartily for this honor."

### SPIRIT OF THE ANNUAL MEETING

*There is one ruling and one central motive which every member of this Society and every citizen of this country should set up, the concentration of intellect, strength, resources and life, if necessary, to a satisfactory ending of this great war.*

*Mr. Charles T. Main*

*In the changes that are coming, the engineer can no longer dwell within his technical shell, and he must prepare himself to become a citizen of the world upon whose shoulders great economic and social burdens are placed.*

*Dr. Ira N. Hollis*

*If we have not at this moment a clear vision of whither we are tending, now is the time of all times to take stock of ourselves and to redirect our course, whether this course is in conformity with time-honored definitions or not. Change is not necessarily synonymous with progress, but there is no progress without change. No one can doubt that the scientist and the engineer are to be the most important industrial figures of the near future. If we are faithful to our duties we shall be of greater importance politically and socially, but to accomplish this we must broaden our vision and get about our business, which is the industrial organization of our country.*

*Prof. Dexter S. Kimball*

*You engineers, all, constitute one of the two professions that are indispensable to the country in the carrying on of the struggle to which the people of the United States are about to devote themselves, yours and the medical profession. . . . the engineer students and the medical students should be required to go on and complete their preparation as engineers and physicians, so that they may become engineers and doctors, and then be gathered into the service of the Government in this war. . . . .*

*Hon. William H. Taft*

### ADDRESS BY EX-PRESIDENT TAFT

In introducing Hon. William H. Taft, Ex-President of the United States, who delivered a stirring address on the nation's call to the professional man, published in full in this issue, Dr. Hollis could not resist relating a little personal experience, saying:

"Last year I came to the annual session fresh from a meeting in Worcester, which I attempted to attend with our ex-president, by way of a freight elevator. The elevator went down, not up, and we stuck until we had unloaded a few of the heavy men into a dark cellar. I was there struck with the admirable good nature of this evening's speaker in assisting to tide over the embarrassment of the elevator man, and of his escort to the platform. His wide sympathies cover a vast range, from the administration of a nation's business to the simplest affairs of daily life. He is equally at home with a school boy on the train as with the representative of a great empire. He can say, in the words of Terence, '*Homo sum, et humani a me nil alienum puto,*' a free translation of which: 'I am a man, and nothing that relates to man can be foreign to my heart,' expresses him exactly.

"We welcome him here as one of ourselves, as an agent of mercy in this war, and as the finest example of citizenship in a republic, Mr. William H. Taft."

Before beginning his address, Mr. Taft said: "I find that I have come to the meeting of this Society to hear a good deal that I have to defend myself against. This suggestion that the elevator went down because I was in it is not correct—that

is not the reason—that elevator was in the region where the collegiate institution, that fine school over which your President presides, conducts instruction in the matter of mechanical engineering (loud laughter)—he just had not calculated the load, that was all."

### THE ENGINEER AND THE WAR

On Wednesday began the professional sessions of the meeting, starting with the all-day war session, at which was given a series of remarkable addresses on the great engineering problems of the war. The opening address by President Hollis on Universal Public Service in Peace and War sounded the keynote. The large audience was responsive to the point of enthusiasm, and reflected the fine spirit of patriotism which was so strongly characteristic of the opening session on the previous evening.

Several of the sessions throughout the convention were inspired by the conditions existing in this time of crisis. In fact, the first meeting, that of the Gage Committee, on Tuesday afternoon, was of this character. Many delegates were in attendance representing departments of the Government, gage manufacturers, manufacturers of munitions in this country and Canada, the Canadian Munitions Board, etc. Questions of the certification of gages and the maintenance of standards in order to promote rapid and accurate manufacturing methods were thoroughly discussed.

One session under the direction of the Sub-Committee on Machine Shop Practice was devoted to the question of Inspection, with particular reference to the manufacture of munitions. Another session dealt with new problems of management incident to the war—namely, the employment of women in the skilled industries, and particularly in machine shops; and the training of crippled soldiers, preparations for which are now being made by the Government, in order that maimed or crippled men returning from the front may continue to be useful, self-supporting elements in society.

### PROFESSOR KIMBALL'S ADDRESS

The character of the whole convention was strikingly summarized by Prof. D. S. Kimball in his address on The Relation of Industrial Management to Engineering, who at the luncheon said that "engineering was broadening to include fields formerly not considered related to the profession, and its ramifications are now so extensive that redefining the aims of the Society would be appropriate."

In speaking of the broadening scope of mechanical engineering, and of engineering in general, Professor Kimball mentioned various subjects which cannot be placed in any definite department, but, nevertheless, must be dealt with by engineers as such. He said he would like to have an inquiry made into the aims and objects of our Society . . . in a statesmanlike manner without reference to persons or groups of persons, but with the sole object of finding out what is best for the Society and what will insure to it an enduring future.

"There will never be a better or more opportune time to consider this subject. Every loyal American is now asking himself what are his duties and responsibilities. Every technical school is facing a reorientation of its purposes and aims. As a nation we are facing a period of self-analysis that may result in changing some of our fundamental policies. I am not so sure, for instance, that we shall continue to be a 'refuge for the oppressed of the earth' unless we are quite sure that the aforesaid oppressed are really in pursuit of the liberty and happiness that we all hold so dear. Americanization may indeed be a part of the work of all organized bodies that are interested in the existence of the Republic."

### GENERAL SESSIONS

At the Business Meeting, President Hollis's address dealt with the activities of the Society for 1917, and was in the nature of a report. Following it was the presentation by Mr. W. M. McFarland of a bust of Rear-Admiral B. F. Isherwood, late Honorary Member of the Society. Amendments to the Constitution and By-Laws were presented and voted on for issue in letter-ballot, and other business transacted as recounted elsewhere in this number.

Besides these distinctly war sessions there were technical sessions of the usual high order of merit on the Power Plant, Textile Subjects, the Protection of Industrial Workers, and general topics. In fact, there has never been so wide a diversity of subjects discussed at a convention, and subjects of so great importance, as at the meeting just closed.

On Friday the sessions were fittingly brought to a close by the beginning of one of the most important undertakings in the history of the Society. This was the public hearing of the Power Test Committee, attended by official representatives from various engineering societies, college laboratories, governmental departments, railroads and manufacturing firms. The present Power Test Codes of the Society were discussed and suggestions offered for their comprehensive revision.

### ENTERTAINMENT FEATURES

The entertainment features of the convention consisted of a "get-together" meeting for members, at which the members did as they were instructed—forgot the cares of life and joined in general good-fellowship. Past-President John R. Freeman held the interest of the audience by his amusing and enlightening anecdotes of his trip to the Orient last winter. There were other entertaining features provided by the New York Committee. On Thursday evening, Dr. John A. Brashear gave his remarkably fine lecture on the Science of the Beautiful in Commonplace Things, which was followed by a reunion and dance, at which everyone thoroughly enjoyed himself. This lecture was accompanied by many striking demonstrations which appealed strongly to the sense of the beautiful, and which will long be remembered by the large audience of personal friends who greeted "Uncle John." There was also a ladies reception and tea on Wednesday afternoon.

### REGISTRATION

The total registration was 1965, of which 1115 were members and 850 were guests. This registration exceeded last year's by 88, and was representative of all parts of the country. The national character of the Society, however, was quite as strongly emphasized by the delegates present from the various Local Sections of the Society, of which 19 had representatives in attendance. Important features of the meeting were a Sections' Session, a Sections' luncheon and a Sections' conference.

In this number of THE JOURNAL will be found an account of the sessions devoted to subjects relating to the war, including the address by Ex-President Wm. H. Taft; the business transactions; Sections' Sessions, and Entertainment Features. The address by Prof. Kimball and the account of the strictly technical sessions and of the Power Test hearing will be given in the next issue.

# ADDRESS OF HON. WM. H. TAFT

## Delivered at the Opening Session of the 38th Annual Meeting and Setting Forth to the Professional Men of America What the Country is Fighting For

IT is a great honor and pleasure to be here in this company to take part, if I may so say, in your act of recognition of one of the world-reputed members of the general profession of engineering. Major Goethals, as he was when I first knew him, did build the Panama Canal, whatever he says and whatever he claims. I am able to testify to it, because I was there for eight years and saw him do it, and I know the trouble he had. I know the struggle he had. I know the power of the man in meeting difficulties. I know his tenacity of purpose. I know from its results, not from my professional knowledge, but from its results, his wonderful ability as an engineer in all the fields of engineering, because that task commanded a knowledge of every branch of engineering. I know his power for managing men. I know of his genius of common sense, without which it would have been impossible for him, in face of the difficulties, to discharge the task which he did discharge, and I may say, because an ex-President out of office can say anything—so long as it is truthful—that I am profoundly regretful that the United States and the people of the United States in this great juncture, in this great crisis, have not the benefit of the great ability and great experience of General Goethals. (Loud applause.)

I was a lawyer and I was a Judge, and I was sent to the Philippines. I was sent there—well, I don't know why, but there was more excuse for sending a man there who did not know anything about the subjects with which he was to deal in the Philippine Islands, because there were very few men who did, than there is for putting any man in a position now who does not know a great deal about the subject in respect to which he is to discharge his functions. But, as I say, I went to the Philippines, and while there it fell to my lot to be responsible for some engineering tasks.

We had to do a good deal of engineering in the Philippines, and I came in contact with that very distinguished body of men who have vindicated their existence many a time, and have inspired great confidence in them on the part of the people of the United States—the Engineers of the United States Army (applause), of which General Goethals is a world leader.

And then, when I came here as Secretary of War it fell to my lot to be associated with engineers, civil engineers, who were called in to assist in the determination of a problem that had to be met and solved in the construction of the Canal, and I look back upon my association with men like Alfred Noble; Stearns, of Boston; Freeman, of Providence; Randolph, of Chicago; Parsons, of New York, who is now at the front, and other engineers, with profound satisfaction. (Applause.)

### Engineers and Medical Men Indispensable

Now, you engineers, all, constitute one of the two professions that are indispensable to the country in the carrying on of the struggle to which the people of the United States are about to devote themselves, yours and the medical profession; you as the constructors of all the material and all the equipment of which so much is needed now in modern warfare to make effective the work of our boys at the front, and the medical profession to furnish, so far as may be, the aid in restoring to the ranks those whom the fortunes of war disable.

We have a conscription law, which is justified on the ground that it was a selective draft, and we know that under that law those whose services can be most useful to the country in the trenches will be sent over, and those whose services can be most useful to the country in preparing and in saving men and material will be retained in their places at home so that they may not be wasted in the trenches and elsewhere, in which others could do just as good work as they, others who could not discharge the services required of engineers or physicians.

England has, as you know, made mistakes in her great work that she has done. I do not think we have praised England enough. I do not think we realize how much she has really accomplished. But we should profit by the mistakes which England made in allowing her doctors and her medical students, her engineers and her engineer students to go into the ranks and be sacrificed. Because of this, England has reduced the supply of those indispensable persons, so that she is embarrassed, and greatly embarrassed.

Now, my friends, we ought not to make the same mistake. Congress and the Administration should see to it that the medical students and the engineer students should be reserved for the work for which they are particularly fitted; that the engineer students and the medical students should be required to go on and complete their preparation as engineers and physicians, so that they may become engineers and doctors, and then be gathered into the service of the Government in this war to help the Government in those places in which, as I say, they are indispensable. (Applause.)

Now, there has been a difficulty—there seems to have been a fear that temporary exemptions would mean favoritism, and Congress and the Administration have not been as prudent as they should have been with reference to these invaluable agencies which we should make as strong and as full as possible. Congress is now in session, and therefore Congress ought to take steps to give power, if power is lacking, to the Secretary of War, to the Secretary of the Navy, the Secretary of War particularly, to deal with embryo engineers and embryo medical students, so that we may have as many engineers and doctors as we can possibly have, because we shall need them all.

Of course, other professions are helping too, lawyers and ministers, we are likely to have enough of them (laughter)—and I do not see why exemption should be claimed for them—and being a lawyer I can say so. I do not mean to say that lawyers are not patriotic, that lawyers are not being called upon now for gratuitous services which they are rendering in connection with this draft, but I do say that as a permanent thing their services are not likely directly to promote the winning of a battle like Cambrai, whereas the engineers may help; and it thrills one's American heart to know that the members of your profession, now tonight, are engaged in exposing themselves and fighting for the great cause, in which this Republic is so much interested, and to which the greater part of the world is so devoted.

### MUST TALK ABOUT THE WAR

I was not quite sure what I ought to talk about when I came here. What I have said up to this point, like the President's few remarks, has not been my speech. One cannot come before an intelligent audience like this and fail to talk about the war. I have talked about the war a good deal in various parts of the country and I have been impressed with the feeling that the war could be talked about a good deal more about the country, throughout the country, to the people of the country, with very great advantage. There are so many who are doubtful—they are for the Government and they are for the war, but they are walking interrogation marks as to whether we did not make a mistake here, or did not make a mistake there, or whether we are fully and rightfully in the war, that I think an evangel ought to be preached on the subject to demonstrate that we are rightfully in the war, that we never have done anything that was not justified, and that the cause now presented to us is so righteous that if we are the people we claim to be we must win it if it costs the last man and the last dollar that we have. (Prolonged applause.)

You meet men who are now, after we have decided to go into the war, and after we are in it, who are now "judicially-minded"—that is to say, they do not say they are neutral, but they are judicially-minded. While I am in favor of being judicially-minded, I am not in favor of masquerading under a judicial mind a lack of that fine edge of loyal patriotism that we need to carry this country through the war. (Applause.) I am opposed to apathy; I am in favor of team work, and of knowing why we are in, and what we are going to do, and in favor of being determined to do it. (Applause.)

### GERMANY'S BREACHES OF INTERNATIONAL LAW

You will find this judicially-minded person suggest that we were unneutral during the three years that we were not in the war, because we furnished ammunition and other supplies to the Allies. Well, we had a right to do that, under international law. Germany herself had agreed to that rule of international law with respect to the power and duties of neutrals—not that neutral governments could furnish such supplies, but that neutral governments could permit their citizens to do so, the citizens taking the risk of confiscation of those articles as contraband if found upon the high seas. And there were those who sympathized with Germany after the German commercial marine had been driven from the seas, and they said it was unneutral for us to furnish one side.

The fortune of war was not our fault. The President was right in insisting that we should stand by the rule of international law in that regard, because if by our acquiescence the rule of international law were to be changed, requiring every neutral government to suppress its citizens from carrying on such a trade, it would only make overwhelming the advantages of a military nation that devoted itself, as Germany did for fifty years, to getting ready for this war, a nation which has piled up the ammunition and supplies needed to carry her through years of war. We, if subjected to a war of aggression, would never be ready. We would always be unprepared, and as a consequence, when forced into war, we would have to look about to prepare suddenly, and then find denied to us the right to get our material and supplies from the citizens of neutral nations, under the new rule suggested. Therefore, it would have been the wildest lunacy for us to consent to a change of international law in that regard, and the merits were wholly with the President in taking that position.

But, notwithstanding the fact that we pursued the path of neutrality as laid down by the law, Germany sank an English commercial liner having three thousand persons on board, and sent to their death 114 American citizens by the murderous torpedo which her submarine hurled at this vessel. Then for a year we continued a discussion, arising from Germany's unfounded claim that the vessel was armed; then she sank another vessel under similar circumstances; then we said that we would sever our relations with Germany; then she said that she would discontinue that method of warfare until further notice; then on the 31st of January last Germany notified us, as she notified the world, that she intended to resume the ruthless submarine warfare; then shortly afterwards we severed our diplomatic relations with Germany; then she sank four or five American vessels, returning to this country in ballast, and sent to their death some twenty-five or thirty American sailors; and then we declared that a state of war existed.

### OUR DUTY AS A GOVERNMENT

Now, my friends, is there anything else that we could do but that? That is where your judicially-minded person would come in. The answer to my question depends, first, on the proposition of what were our rights, and what were the rights of our citizens? and secondly, what was our duty as a Government with respect to those rights? International law is indefinite in certain respects, but it is as definite as the law of promissory notes with reference to the rule of the capture of commercial vessels at sea. A belligerent may capture the commercial vessel of its enemy and sink that vessel. It may capture, under certain circumstances, a neutral vessel, violating a blockade, and possibly may sink it, but an incontestible rule for a hundred years has been that that right of capture and right of destruction is subject to one limitation, namely, that the ship's company of the captured vessel shall always be put in a place of safety before the vessel is sunk.

Admiral Semmes in the Civil War sank perhaps four hundred or five hundred vessels of the United States commercial marine, but he prided himself that in all that destruction not one single human life was lost. He was an international lawyer of repute; he was also a naval commander, and his course in that regard is the strongest evidence of what international law is on that point. Therefore, Germany violated the rights of those citizens whom she exposed to death and whom she sent to death. When a man kills another deliberately, without right, it is murder, and there is no other word nor any other term in international law that can be applied to a case where a nation kills men and women and children without right. (Applause.)

### GERMANY'S WARNING OF MURDER

Ah, but it is said these people had notice. That distinguished and eminent Christian statesman, Count von Bernstorff, had whispered over the telephone and had intimated very enigmatically that any one who went aboard the Lusitania would run the risk of being torpedoed, and it is stated that those who went down in ships sunk afterward knew that Germany was on the sea with these murderous instruments. Well, that is a fine plea. Suppose a man in New York should warn a neighbor that he could not go down into the street upon which his house abutted, because if he did he would kill

him; and suppose this man who was warned was a courageous American citizen, who knew what his rights were and he went down into the street, and the threatener did kill him. Suppose that man was indicted and haled into court and called upon to plead, and he pleaded "Not guilty" on the ground that he had notified this man that if he would come down into the street he would kill him, and therefore he was not guilty because the man himself was guilty of contributory negligence in running into a bullet whose presence he ought to have anticipated on the street. (Applause.)

But Senator La Follette says—(hisses on the part of some persons in the audience). oh, don't hiss. it never helps to call names, no matter how poor an opinion you have of a man, it does not help the argument—but Senator La Follette says it is true they had the right to be where they were, but those were technical rights. It is too bad when a senator in Congress, sworn to obey the Constitution, should regard the right of those poor victims on board the Lusitania to life and the right to protection against the invasion of a murderous nation as a technical right.

### What Was Our Duty?

We will now assume, therefore, that this was murder of our citizens. What was our duty? The Constitution as interpreted by the Supreme Court, indeed our general knowledge of government, would teach us that while we owe service, military and civil, to the Government, the Government owes us as a primary consideration, protection. Government is nothing but a partnership in which we are all members, and we all agree to contribute to the objects of a partnership by service; and then the partnership is to help us in enabling us to enjoy our rights. Therefore, when these citizens were actually deprived of their rights, why, it is very plain that it was the business of the Government to call for reparation in respect to those whose rights had been taken away, and security and an announcement of the policy which would prevent subsequent interference with similar rights of our citizens. Otherwise, if not, then we ought to go out of the government business, because that is the object of government.

Now, Germany announced that she not only justified what she had done, but intended to continue to murder our citizens on the high seas. Our citizens are entitled to the protection of the Government at home and on the high seas, and abroad. Abroad there is some qualification, because they voluntarily submit to another jurisdiction, but on the high seas, on an American vessel, and under an American flag, on that great road of the nations, they are just as much within the jurisdiction and within the protection of the Government at home as if they stood on the shores of New York, or Massachusetts, or New Jersey, and an invasion of their rights on the high seas by a foreign government is just as much an invasion as if Germany had landed a Uhlan regiment on our shores and shot into the homes of American citizens and killed them.

Therefore, if we were to continue business as a government, there was nothing else for us to do—Germany did not leave it open—except to measure swords with her in protection of those rights. If this act had been committed by Venezuela or Costa Rica, if either of those countries had sunk an American ship with a loss of one hundred lives, the President would have promptly sent a message demanding reparation and security against further invasion, and might have sent a warship down to convey the message, just by way of suggestion, and every man, woman and child, Senator La Follette, and every pacifist, would have said, "Well done." Well, now, what is the difference between that case and the one we are considering? There is not any in principle, but there is this real difference, that Germany is the greatest military power in the world, and Venezuela is not, and therefore we are very urgently and strongly in favor of the protection of the rights of American citizens when invaded by a foreign country, provided the country is little enough, but when it is a great power —the greatest military power—then the rights are "technical." (Applause.)

Oh, my friends, there was not anything for us to do except to declare war, and a pacifist or anyone else who says otherwise or intimates otherwise, does not understand. The President has set a precedent by calling them stupid, and, after such an authority, I am willing to say I agree.

Now that brought us into the war, but when we got into the war we found what possibly we ought to have known before —some did know—that the particular cause which brought us in was only a phase of the far greater cause which the Allies were engaged in fighting. We found ourselves in the beginning ranged with democracies against autocracies. I know that our judically-minded friend will suggest that England is a monarchy and so is Italy. Yes, that is true, but a democracy is a country in which the people rule, in which the policies of the government are determined by the popular will. The proof of the pudding is in the eating of it. Any one who knows anything about England and Italy cannot say otherwise than that the people rule in these countries, and where that is the case they are democracies. Where that is the case, the question of kings is only a question of taste. As a matter of fact, the King of Italy and the King of Great Britain have not any more to do in determining acute questions of the polices of their respective countries than an ex-President of the United States has. (Applause.)

### The Meaning of Democracy

Now, the President has said that we are fighting this war to make the world safe for democracy. That is a truly exact statement. But it has been misconstrued. It does not mean that we are to force democracy on other countries, that we claim to have a patent for our form of government that we are going to drive down the throats of other people. That is not what it means. It only means that the power of a people with a military and foreign policy such as that of the Imperial German Empire, is dangerous to the continued and safe existence of smaller and less powerful countries that desire to have democracies and to work out the happiness of their people through that kind of government. That is what it means

### We Must Understand German Character

We cannot understand the issues at stake without understanding the character of the German people. We cannot understand their character without following their training in the last fifty or sixty years. We all have known Germans. We have liked them. When in Germany we have enjoyed seeing them. They are a kindly people; at least they were some years ago when I visited Germany. They are a kindly people, who love their homes, they love their families, they love music and they love poetry, of which they have some of the greatest exponents in the world. They conform to authority with a kind of pleasure. They are an intellectual people, they are an earnest people, a little lacking in a sense of humor, but a great people, people capable of great effort.

The truth is, while I have a profound admiration for the

English people and the history of England, because having been educated as a lawyer I believe she laid the foundations of true constitutional liberty, nevertheless, I am bound to say that when I went to Europe and traveled in Europe, I would a great deal rather be closed up in a railway carriage with a German than with an Englishman; because the Englishman —I mean the regular Englishman—was constantly engaged in an affirmative effort to convince me that he did not know I was in the carriage, whereas the German was always courteous and friendly and anxious to engage in conversation.

### SOME GLANCES AT GERMAN HISTORY

The Germans for a long time were divided into twenty-eight different States, Austria the greatest of them, Prussia the next, and twenty-six others, and every one who longed for an improvement in the world, and an improvement among the Germans, wished for unity among them. There were liberty-loving Germans, and in '48 they rebelled against the Divine Right of Kings, and they had revolutions. They were not successful. They did get a constitutional monarchy for a little while in Prussia, and offered the crown to Frederick William, the great-uncle of the present Emperor, and he said he would not take it, because he got it from God, and did not purpose to take it back again out of the mud, showing that the Divine Right of Kings came honestly down that line to its present exponent.

A large number of these liberty-loving Germans were driven out of Germany and came to this country, and made one of the most valuable elements of our citizenship here (applause), and when the Civil War came on, loving liberty as they did and hating slavery, they went into the war, enlisted in great numbers, and on every battlefield in that war the blood of our German citizens was shed.

Their descendants and others who have come here since have continued to make a valuable part of our citizenship, and during these three years when we were neutral they have naturally, because of their pride in the success and prosperity of their brethren at home, had a sympathy with Germany and listened to the arguments in her behalf which have been put forth in this war. And now the war between America and Germany has come on, and their allegiance requires them to be loyal, and they are put in a sad position, and one in respect to which we should be considerate of them. But they are loyal, they have enlisted, they have gone into the draft, and contributed to the great patriotic funds; and while they are not vociferous —we could hardly expect them to be so—that they are going to be loyal I have not the slightest doubt (applause), and one of the things we ought to be most thankful for is that very thing. The reason why Germany treated us as she did was because she counted on dissension among our people, growing out of the disloyalty of that very element, and she has been disappointed in that regard as she has been disappointed in so many of those instances where she has attempted to read the motives of other people.

Instead of founding a constitutional monarchy, with representative institutions, and bringing about unity, as those leaders of German thought, Carl Schurz and others hoped for, there came into the history of Germany a very different individual, Prince von Bismarck, who was the Premier of Prussia in 1862. His theory was that he would conquer and unite the German nation by blood and iron, and he developed the army, always a well-controlled body in Prussia, and he made the nation into an army, and an army into the nation, and then he planned the wars upon which he founded the unity of Germany. He became involved in a quarrel with Denmark, and induced Austria to go in with him, and took away Schleswig-Holstein from Denmark; and then when he got it, he found it was so easy that he annexed it forcibly to Prussia; and when Austria asked, in a diplomatic way, just what there had been in that war for her, he said there was not anything. And then he got into war with Austria, as he had intended, and in six weeks he wiped her off the map of Germany. Then in that war he annexed forcibly Hanover and Frankfort, and made an offensive and defensive alliance with Württemberg, and Baden, and several other German countries; and then he sat down to wait until that fakir, Napoleon III, in his pirouetting, would bring about an appearance of a war of aggression against Germany, which was exactly what Bismarck was waiting for, and he only had to wait four years for that; and if you will read his memoirs you will see how he brought that about. You will be interested in reading, I am sure, that interview between himself and von Roon and von Moltke. They received a telegram from the Emperor outlining an interview between him and Benedetti, Napoleon's Ambassador, and they were thrown into gloom, because the interview was one which seemed so pacific to them that they thought its publication would prevent war; and Bismarck sat down and, without changing the body of the message, changed a few words in it and published it; and then von Moltke said—"Now we will have war." He said—"That telegram, when it came, sounded like a parley. As you have changed it, it sounds like the rattle of a drum." This was stated by Bismarck himself. So, true to his plan, Napoleon declared war, and then, in a short time, Bismarck defeated France and took Alsace-Lorraine and an indemnity of a billion dollars, which the Germans put into the army, and Bismarck crowned a Prussian King Emperor of Germany at Versailles, and he went back to Berlin and sat down as the head of the Empire to digest the pieces of territory he had bitten off in the last three wars.

### BISMARCK'S SEEDS OF KULTUR

He was not in favor of world dominion. He wanted to raise Germany to a great power in Europe, and he succeeded. He made fun of the ideal of world dominion, but there was held out to the German people the idea that all the rest of the world would try to get back from them this territory which had been taken, and therefore they must defend themselves, and so they went on and provided greater and greater armies.

They also adopted in their wonderful way, as you gentlemen of science know, the principles of science to the manufacture of everything, and to every field of industry and business. They introduced a system which they called Kultur, and which brought about a prosperity in competition with the world that attracted the admiration of the world. Their population increased and pressed upon their borders, and with their marvelous successes in the three wars, with their wonderful administration and the demonstration of their efficiency in their prosperity, and with their increase of population, they acquired megalomania, and they learned to think that they were supermen. They believed they had invented Kultur, and it was their duty to spread it over the world and enlarge their borders and conquer the world for the purpose of spreading that Kultur.

And they soon, by reason of their elevation as a people, associated themselves with God. They regarded themselves as the agents of God. They are a people of an inexorable logic. If they begin with a false premise, as they often do, their confidence in logic is such that they wipe out any fact

that is inconsistent with the conclusion reached by that logic. You remember the story of the old German who was in the California gold diggings and met a man out there whom he had seen only recently in New York; and anxious to find out how he had gotten there he asked: "You came the plains across?" The man replied, "No." "Then you have come the Isthmus over?" "No." "Oh, then you come the Straits of Magellan through?" "No." "Oh, I see, you were seasick coming the Horn around?" The man replied, "No," and then the German's eyes opened and he looked at the man for a minute and he said: "Well, then, you have not arrived!" (Laughter and applause.)

Having established that Kultur was necessary for the world, and that they had invented it, they believed that they were the people to spread it; and then, with that inexorable logic, all of these other conclusions followed. The State, the German State, was to spread Kultur. It was to do God's work. Therefore, every consideration must yield to the doing of that work. The State was above everything. The State, engaged in this work, could do no wrong. Therefore, these considerations of honor and decency, and the performance of obligation, could play no part. International morality was eliminated. The only sin of a State was weakness; its virtue was power. And that doctrine, or its elements, the idea that Germany was over all, was preached in the schools, in the academies, in the universities, by the great lecturers, by the military writers; and the conviction grew with the people, first, that they must protect and defend themselves and give everything to the Army necessary to accomplish that, and, secondly, that they must base their State on force and maintain that force in order that they should spread Kultur to the world by domination and conquest. They eliminated, as I say, international morality.

Now, that is the nation and that is the people that we are engaged in fighting. They are obsessed as with insanity, otherwise you cannot explain what you see and read and know. "Why is it," you ask, "we did not know this before we got into the war?" Well, we read excerpts from the lectures and military writings, but we have cranks of our own—I need not mention them—but certainly we do not want to be held responsible for their writings and their statements and their actions, and we assumed that these people, thus speaking among the Germans, belonged to that necessary and conspicuous, but we hope with us unimportant, element. But it was not so in the case of Germany, and you can read now the books that have been prepared impartially showing these sermons and lectures, and showing that these lectures spoke for all the people. Consider, for a moment, that there was a writer who in one of his writings incorporated a prayer like this:

> Oh, Thou, who presides over all, up above, high in the skies, up above the Cherubim and Seraphim—and the Zeppelins—

Now, that association, if it did not shock your feelings as irreverent, would suggest a humorous view; but to the German mind, with the idea of what the zeppelin was do to in spreading Kultur, it was the agency of God; the association between the cherubim and seraphim, which are supposed to be God's agents, with the zeppelins, was entirely proper. They preached sermons on the German God.

### We Are Fighting the German People

It is the people of Germany we are fighting, with the characteristic they have of subordination to the authority of the Prussian military regime and the Kaiser, and we must not assume they are compelled against their will to do this fighting. They have made too many heroic sacrifices in loyalty to this false idea, and in loyalty to the leadership of the Kaiser, and therefore what the President says must not be misconstrued. What we are trying to do is to separate the people of Germany from the rulers of Germany, but the only way we can separate them from their rulers is by hitting them on the head with a club so that the psychology of the situation will be brought home to them. (Great and prolonged applause.)

If you look for proof of this position of Germany with reference to the abolition of international morality you can find it in their method of warfare. I do not think it necessary to go into a detail recital of the awful atrocities that have been proven before you can arrive at a general conclusion as to their violation of every rule of warfare. They bombarded unfortified towns, an act which is forbidden by international law, and the men who bombarded these unfortified towns on the east Coast of England were rewarded by being decorated with the Iron Cross.

The Hague Conference provided certain rules with respect to the carrying on of war by means of aircraft, one of which was that belligerents were not to drop explosives from aircrafts on undefended towns; and the Germans promptly sent their zeppelins, that were assembled for the purpose of carrying on war, and to which they turned for the purpose of carrying on the war, and they sent these zeppelins to England and slaughtered innocent non-combatants. Of the thousands of victims of the zeppelin raids, possibly not more than fifty soldiers and sailors were hit, and only one or two arsenals, but the great body of the victims is composed of women and children, and old men. The men who navigated the zeppelins in these air raids were also rewarded with Iron Crosses.

### The Path of Kultur

When the Germans entered Belgium they violated their treaties through which they had given their plighted faith for sixty years with the other nations. You would think, when they went into Belgium, under those circumstances, they would treat the people with some consideration, even in spite of their obsession. Did they? No. What they did was to take a district in Belgium and direct their soldiers to pursue the policy of Schreeklichkeit, that is, to stand up against a wall the leading citizens and shoot them, as well as the women and children. You ask for proof? Well, read the report of Lord Bryce. He is a lawyer, an able lawyer, and an historian, and he was on the Committee with other lawyers and Judges, and they took the evidence and dissected it and analyzed it. They rejected all the evidence as to the sporadic brutalities by soldiery which you encounter in every war, and took only the evidence of cases that could not have been committed except by the order of officers, and they showed that this was part of the military policy of Germany in terrorizing the rest of the innocent Belgians by such cruel atrocities in respect to the families of this particular little district.

But the worst thing they have done has been with respect to Armenia. When England brought over the Indian troops to help that small regular army of hers, and they came and made good soldiers, showing they had been well treated, the Germans held up their hands in holy horror and said, "They are sending Mohammedans to fight Christians," all the time having that eminently Christian Monarch, the Sultan of

Michigan

Turkey, in alliance with them. And after the alliance was secure, then Turkey proceeded to carry out a purpose that she had partially attempted to carry out years before in ridding herself of Armenian Christians in her Empire. She proceeded, with Germany looking on, and with officers of the German Army at hand, through her regular soldiery and her irregular soldiery, to murder eight hundred thousand Armenians because they were Christians. Now, that is an evidence of the false philosophy, the horrid philosophy, that there is no international morality, and that nothing should stand in the way of military success and the advance of the State in the spread of kultur.

That is the kind of enemy we have to fight. That is the psychological state of the German people, and the only way in which we can change it, as I say, is by defeating them. If we defeat them, then they will appreciate the falseness of a philosophy which can only be justified by victory, and then when they are defeated, as we must defeat them, then they will relegate the Kaiser—it will not need any action on our part—they will relegate the Kaiser and the Prussian military regime to the place where they ought to go. (Applause.)

It is a very satisfactory thing to see that the sin of the Germans in this regard has found them out. When the war began, good Christians hesitated about believing in a good God, when they saw that so many innocent men could be hurled into a vortex of destruction, agony, suffering and death like this. Now the thing is cleared away, and what we see is that the world has been suffering from a cancer of militarism, and Germany has been responsible for it, and she has led the world on to these great armies, and on her hands is the blood of this awful war—this war with fifteen or twenty times the number of men engaged in it, and with an equally increased amount of suffering and agony, compared with any other war—with 40,000,000 men engaged, 7,000,000 men dead, 6,000,000 men in the hospitals, and 6,000,000 men in prison camps. That is due to Germany. The causes cannot be cut out but by suffering. God works by inexorable laws, and the penalty of sin must be paid.

This is a German war of aggression as any schoolboy can now see. The White Paper did not show any communications between Germany and Austria during that anxious time, and they have never been disclosed, but we know now that Russia was not prepared, and England not any more prepared than we are today, and France was very lacking in her preparation, and yet we are to believe that these three countries conspired to attack Germany who was ready to the last cannon and the last reservist. Why, that is enough to make a horse laugh. It is true that Germany did not advise the killing of the Crown Prince and his Consort. That is not the way Germany has begun her wars. She gets ready. She plans a war. She gets ready, and then she waits for the opportunity so that it shall seem to be a war of aggression by other powers. That is true in every war she has waged since Prussia has been in power.

### GERMANY'S WOEFUL BLUNDERS

So to go back to this sin of Germany finding her out. She has been perfect in military preparation; she has been perfect in military strategy, but where has she made her blunders? She has made her blunders, and her great blunders, in misreading other peoples, in her diplomacy, and she has made these blunders because she has eliminated from her own soul considerations of morality and motives of good, motives of service and allegiance and unselfishness, and therefore she has eliminated those from her judgment when she goes to judge of what other people will do. So she made a mistake about Great Britain, and her conscience in respect to Belgium. She made a mistake as to the British possessions—I mean those independent dominions—she said, "The tie which binds the dominions to the mother country is very light. There is no reason why they should go in, there is nothing in it for them," and she was indignant and exasperated when she found that her judgment in that regard was wrong. That is because she could not appreciate the filial relation between those countries and Great Britain. She could not appreciate the daughter's loyalty to her mother that had protected her. Is there anything more noble in this world war than the way in which Canada and Australia have responded to the call of the mother country? Canada has sent 420,000 men, and Australia 400,000 men, Australia having a population of five millions and Canada six or seven millions. In proportion, we would have to send an army of seven millions. And then France. Germany said France was decadent, permeated with socialism, no patriotism, and deeply affected with frivolity. France was not prepared, but she rallied her legions, and is it not inspiring to think of the fight that she made, knowing that the German military staff was attempting to crush France first, and she stood up, and with that thin line of the British regular Army, she hurled back the German hordes at the Marne and saved the world. (Great applause.)

The biggest mistake she has made has been with respect to this country. I remember some of the things the papers said—they said we were a tangoing nation. They said we were too fat to go into the trenches. They had a contempt for us because we had not prepared for war. They assumed our citizenship of German origin would prevent the war, and political considerations would divide the people in that regard. They were also obsessed with the idea that they could end the war with this murderous weapon, this weapon they could not use except by accompanying its use with the murder of neutral people. So they went in.

Now, ten, fifteen or twenty years hence, when our grandchildren go to their fathers, after having read a history of this war, they will say—"Papa, why in the name of common sense did Germany force the United States into this war?" And papa will have a hard time to tell, unless he goes into all of the circumstances and treats the subject from a psychological standpoint, because the boy will say, any child would say—"Why they had been fighting this war for three years, exhausting as no other war has been before, so that they were all not exhausted, but nearly so, and at that time they deliberately forced into the war against them that gigantic young nation that could furnish what is absolutely necessary, and what must determine victory in the war, more food, more money, more fighting men than any nation in the world."

Now, that is what they have done, and nothing can explain it except the obsession that I have referred to—their failure to see things in other people, because they have eliminated from their own consideration those moral motives. Now what are we going to do about it? I have said, potentially, we are the greatest power in the world. We are a potential military power, and we have got to make that thing which is potential actual, and that is no mean job. We have before us a war of two, three or four years. We have got to raise an army of five million or seven million, or possibly more. It is manpower that is going to win this war. Russia has become a pulpy mass, and it has got to work out its own salvation. There is one feature about that situation, and that is that the

Germans will not know any more about what is going to happen in Russia than we do, but it is going to enable the Germans to bring back, doubtless, many of her divisions to the Western front; and we must fight the war out on the Western front, and it may be that the Western front will reach from the North Sea to the Adriatic. We have got to furnish to our Allies not only food, not only money, but we have got to furnish them the man-power that will give a predominance that will win this war. We have got to wear them out, it may be by attrition, as Grant wore Lee out, but we have got to do it, because civilization depends upon it, because our own independence depends upon it. The war is not in our souls yet, not as it will be when our boys are shot down, and when we consult the casualty lists to see whether those dear to us have suffered. One of the great satisfactions is that when we are in it, when we meet disaster, as we are going to meet disaster, and we find there have been blunders, as there will be blunders—but from these blunders and from these disasters the American people are so constituted, with their inherited traits, that those disasters and blunders and defeats and humiliations will only make us stronger to carry out the struggle that is essential to liberty and Christian civilization. (Loud applause.)

# KEYNOTE SESSION

## An All-Day Meeting on the Service of the Engineer to the Public in Times of Crises, with a Series of Addresses on Great Engineering Problems of the War

THE topic now uppermost in the minds of everyone, and engineers in particular—the war—served as the basis for an all-day session in the Auditorium on Wednesday, December 5, which attracted large and deeply attentive audiences both in the morning and afternoon.

Promptly at the opening hour, President Hollis, after a few preliminary remarks, called Vice-President Charles H. Benjamin to the chair and then launched into his stirring opening address on Universal Public Service in Peace and War, in which he sounded the keynote of the day's discussions in his illuminating development of the thesis that training for citizenship is the safeguard of democracy, and emphasized the relations and duties of the engineer to the state in the present great emergency. Four additional addresses were delivered before the luncheon intermission, as follows:

THE ENGINEERING SOCIETIES IN THE NATIONAL DEFENSE, Gano Dunn.
SPECIAL EDUCATION IN TIME OF WAR, Dr. Charles S. Howe.
ENGINEERING RESEARCH, C. E. Skinner.
THE AGRICULTURAL PROBLEM, L. H. Bailey.

The afternoon session began promptly at 2 p. m., Vice-President Charles T. Plunkett officiating as chairman on the invitation of President Hollis. Five addresses were delivered at this session, namely:

THE FUEL PROBLEM, Prof. L. P. Breckenridge.
MOTOR TRANSPORTATION, William P. Kennedy.
ARMY TRANSPORTATION, Major L. B. Moody.
THE AIRCRAFT PROBLEM, Prof. W. F. Durand.
THE SOLUTION OF THE CANTONMENT CONSTRUCTION PROBLEM, Leonard Metcalf.

The texts of these ten addresses immediately follow.

## UNIVERSAL PUBLIC SERVICE IN PEACE AND WAR

BY DR. IRA N. HOLLIS, WORCESTER, MASS.

OUR profession has long been classed as one concerned only with the application of science. It covers a very wide range reaching, on the one hand, from invention and construction that affect the whole history of this race, on the other hand, to the little things that add only to convenience and comfort in our daily lives. Transportation, for instance, in opening to every nation the products of all others, and in permitting the ready ebb and flow of travel, has had a profound influence upon industry and upon the world outlook of men. Our thoughts have sprung beyond national barriers. This war is a temporary setback, but we shall come out of it stronger than ever for human brotherhood.

In the changes that are coming, the engineer can no longer dwell within his technical shell and he must prepare himself to become a citizen of the world upon whose shoulders great economic and social burdens are placed. He must study history, the science of government, and the problems of labor, that he may grow to the maximum of his possibilities. His training has fitted him for anything, providing he does not stop all the humanities after leaving college. His work will be better done for conscientious performance of civic duties and, if thereby he is drawn away from technicalities, his education will have justified itself. At this time there is nothing more important to him than a clarification of his thoughts on government and public service. He cannot afford to remain outside the life of the nation, and he must exert himself to do and to know. For that reason, it is a happy thought on the part of the Meetings Committee to set apart this day for public questions. The first thing in any discussion is a courageous look into our shortcomings as a nation. We have the faults of youth, not because our form of government is inferior, but because it is superior. We impose only as much government on the individual as is absolutely necessary to hold society together.

The great difference between the Allies and the Central Powers lies in the attitude of the individual toward the state. Two conceptions are found in modern times; one springing out of Rousseau's revolutionary doctrine that government is derived from the consent of the governed, and the other from the ancient divine right, under which the governed derive their privileges from the consent of a ruling class, or of a crowned head.

In the first case, society regulates itself and the state is wholly a possession of individual citizens. In the second case, society is regulated by those set above, and the individual belongs entirely to the state, in whose service anything may become justified. These two ideas lead to characteristic failure when carried to extremes; as, for instance, in a democracy, liberty unchecked by public opinion is likely to become license, and freedom may mean simply the power to do as the individual pleases, without reference to the common welfare; equality would be nothing but a dead level of property under this theory that would render democracy the most oppressive socialism. In an autocracy, the individual, as the

property of the state, may become a murderer, a liar, a thief, and the lowest of conspirators without loss of station, provided his deviltry is committed at the behest of the ruling power. Secret diplomacy against the well-being of other states will always flourish under a military autocracy.

In the first of these cases you have the destruction of individual conscience as related to the state; in the other, the complete breakdown of national morality in relation to the world. We have these two extremes at the present time side by side in Europe: Prussia with the unbridled license of the ruling classes to do evil, that their good may spring from it, and Russia with a complete collapse of state morality in the hands of ignorant socialism.

### Training for Public Office

Extremes in government are always wrong, and wise men have studied for ages how to check that tendency. It is perhaps the most important problem that we have in our own country, where every individual can express his views freely without fear of being arrested for adverse criticism against a dynasty. Every public officer is a public possession, and can be dissected without any hindrance on the part of the law. This implies for success in government a self-control that comes only with training, and the American people may well pause to think more seriously about training for public office and for citizenship in a democracy. We have had very loose views on this subject ever since the formation of the Republic. Anyone may be put into any office on the principle that American common-sense will somehow muddle through. Hence this subject is more than timely. It is the psychological moment when all people, especially the engineers, should strike a good blow toward the education of men and women for service under the state, and for that kind of self-control and sacrifice that produces efficiency in a republic.

As a matter of fact, this whole subject is of vastly greater importance at this session of The American Society of Mechanical Engineers than any technical or professional paper could possibly be. While a single invention may often change the whole course of human history, the freedom of man for his own development is so dependent upon his training, or education, that we as engineers ought now to turn our minds entirely away from technicalities of science to the fundamental rules upon which all society must be based. We are citizens first, and engineers afterwards, and while we know that the externals of civilization have only kept pace with the progress of our profession, we know also that the spiritual side of man's nature is a development of the geologic ages. Short periods of history disclose relatively little change. During nineteen hundred years of great material growth, humanity as a whole has not taken a single step toward the realization of human brotherhood, except, perhaps, in the surrender of legal ownership in slaves. The mechanic who works for us lives in a style that a monarch of the middle ages might have envied. A traveler four thousand years ago coming out from Egypt would have written a book about his adventures in crossing the little arm of the Mediterranean, called in ancient times the Syrian Sea. But we moderns have many in America who consider a journey around the world only an event worthy of an evening's conversation with a few friends. Through engineering we know the world and every corner of it, as our grandfathers could not have known it. We know how nation has come to be dependent upon nation. Yet ethically we are still as blind as the money changers who were driven from the temple by Jesus Christ, and we are fighting the most horrible war in all history.

### Engineer's Task in War

Every war has its roots deep down in the history of the race, and it is often very difficult to trace the causes. In our Spanish War the immediate cause, or the immediate event, that brought about the war, was the sinking of the *Maine* in Havana Harbor under circumstances that seemed to put the responsibility on the Spaniards. The real basis of the war dated back for generations, and was only the result of many struggles against the autocratic power of a nation exploiting American colonies for its own benefit, without any reference to the good of those who were exploited. This war too is the result of great forces that seem always to have existed. It is made more horrible by the inventions that began with James Watt's improvement of the steam engine into a workable machine. While it is not caused by the work of the engineer, it is essentially an engineer's war, in the respect that it uses all of his talent toward making the war more terrible. It is the culmination of the century of invention that followed Watt, and represents a struggle between those who have deliberately conspired to make use of all human resources and invention for securing dominion over the world, and those who believe that man advances in true happiness under individual freedom far better than under the direction of autocracy.

It is our task as engineers to assist in making the world safe against the forces that we have unloosened, so that the century may not close with a total failure of the civilization of Christian races. It is we who have developed the applications of science, and it is we who are using it to destroy one another, forced into the struggle by the rulers of a nation that knows no right except might, and no mercy except that which is taught them by the sword. Our great problem will be, not how to develop further, but how to tame what we have. Unless some conscience is aroused that science is not to be used against man, but for him, then it will never be safe for this world. It will always be an explosive ready to go off and destroy. The poisoning of wells is nothing beside the reversal of preventive medicine into a destructive agency. Every practical invention can be turned into evil for destroying the white races in favor of the yellow and black men, who have no science.

### Best Training is Educated Conscience

We as engineers must take our share in quickening the conscience of the American people toward the danger of unlimited, unchecked forces, and in preaching night and day the importance of an educated conscience. That is, after all, the most effective training for public service, and the best antidote against the unholy advance of scientific brutality.

It is a curious thing that James Watt should have been prevented from practising a trade that he had learned in London by the trade guilds of Glasgow. The potent influence over his life and over human history sprang out of his having been driven to take refuge in a university as mathematical instrument maker, where he was called upon to do all kinds of odd jobs in connection with a physical laboratory. By a strange irony he improved the steam engine and thereby let loose the forces of labor-saving against the trade unions, thus creating problems infinitely more difficult than anything connected with labor a century and a half ago.

In what respect is democracy to be preferred to an autocracy which safeguards the material welfare of its citizens, and provides through state regulation for their comfort? That question is an important one before the American people, and we

should study it in order to understand and buttress our own institutions. Our education has taught us that there is only one answer, and we believe that science is safe only in a democracy such as ours.

Efficiency has come to mean something new to us, and by it we can make an adequate comparison between the two forms of government, but we must take efficiency in the most comprehensive sense of the word. It is nothing to mankind if by reducing the labor required to produce the necessities of life, it simply enables a country to support a larger population. The thing worth while is righteousness and satisfaction in our lives, not a larger number of human beings on this planet. One can express but little sympathy with certain exaggerated notions about race suicide. There is no such thing. There is an ebb and flow and a divine law under which some families gradually die out and others come up to the great places of the world. Race suicide, if it existed, would be found in unsanitary conditions of life and in the recklessness by which children are often born into the world.

The best definition of efficiency, if it is to be used as a measure of civilization, has an ethical as well as a material sense. Germany has undoubtedly made an enormous advance in material wealth and in the applications of science. Her ruling classes have also provided for the welfare of the masses, perhaps better than any other nation. It is the concession that they had to make in order to keep a large population contented with their lot. That is their share in the government. But Germany is not efficient in the best sense of the word. Her scholars and her statesmen have betrayed her. One has only to read the paper signed by a number of professors to reach the conclusion that there is too much professor in Germany and too little humanity. The world has been hypnotized up to within a very recent period by Germany's own claim of preëminence and the shock of this war's disclosure is as much a sense of disappointment as it is a revulsion against the professors' claims.

### Some Woeful German Weaknesses

Germany is not efficient in her relations with other nations. She is not even efficient in her spy system, for her spies are but children in the hands of Americans. Germany is not even efficient in her science and literature. She is woefully behind the English and the French, except in those applications that bring wealth and power.

In some article President Eliot has well stated what he calls "the precious lesson of the war." "Toward every kind of national efficiency, discipline is good and coöperation is good; but for the highest efficiency, both should be consented to in liberty." We are now going to prove this with the blood of our sons, and unless we succeed against Prussia our constitution will be subject to modification, and we must begin again, like Sisyphus, to roll the rock up the hill in the hope that next time it will not slip away from us to roll back.

A power of initiative in a free government and a power of initiative of its citizens is certain, in the long run, to triumph over a national organization created by a few who have carefully directed the thoughts of the masses. If we put Kaiser Wilhelm alongside of Abraham Lincoln, we see in his royal person only a belated barbarian come back out of a shuddering past to destroy all that humanity has gained in the fight against slavery. We know that the heart of man beats for the freedom of the individual, and that only the drum beats for the divine right of kings. Not one word that Lincoln has uttered is false to the doctrine of Christ. Scarcely one thing of the Kaiser's might not have been said by a heathen king. The whole Christian religion is based on the right of the individual to a life of his own, subject to a true adjustment to the Almighty's laws. Democracy is a final form of government. It may have its failures, and if it fails now it will come again and again until the whole earth is freed from the privilege by birth and the rule of a few.

### What Americans Also Lack

All preparation for public service must be based upon a foundation of good citizenship in our whole country, if our officials are to serve well in this republic. A human pyramid can be formed only with strong men at the bottom, and no first-rate public service can ever be built up on a flabby, careless attitude toward civic duties. America is young yet. It is like a boy who has grown far too rapidly, loose-jointed and tall, with unlimited possibilities after his frame shall have been knit into a solid mass. One hundred and twenty-eight years is not enough to bring a nation to its majority, especially one made up of such diverse elements as ours, the dumping ground of all the world for the oppressed and the poor.

Our neighborhood and our international ideals are sound. They are found in the Bible. At the same time we lack cohesion and public conscience in relation to our own Government. Every individual must be regarded as part of the public service, and the first thing he must acquire, whether he be native born or immigrant, is public conscience. In some way the ordinary citizen too often argues that because this is a government by the people and for the people the state owes him something. In that respect, our patriotism is in part a sham, and we have plenty of evidence to prove it. A considerable fraction of the annual appropriation in Congress is the result of a trade among localities, each of which wants something out of the general treasury. The pension bills have been only too often the sop for voters, and capital and labor have already shown us more than once how little they care for the great mass of people whom they class as the public. In the lynching of criminals, and sometimes of innocent people, we find nothing but a total disregard for the good name of the state. These are our failures and we must get rid of them, in order that the beauty of democracy may not be hidden beneath its excrescences. In the matter of public conscience we need a religious revival, and the churches ought to take a share in this. It is their task, as well as ours, to lift this side of our national life.

### Elements of American Citizenship

The first demand of our republic is, then, an educated public conscience. No man should expect more from his country than he is willing to give it. Those who whine about injustice in modern society are usually getting about what they deserve.

The second demand on every citizen should be a knowledge of our institutions and the method of government. It goes without saying that the English language is an absolutely essential foundation for this. Most failures in citizenship proceed from ignorance and carelessness, rather than from viciousness. The normal American is right-minded and is morally upright, but slack in his responsibilities to the public. The moonshiner in the Cumberlands makes whiskey because he neither knows his relation to the body politic, nor the evil effects of drink. His whole conception of government makes it something separate and apart from himself, an attitude of mind that, if carried to its logical conclusion, breaks down all government and ends in the ghastly travesty set up by the ignorant peasants and workingmen of Russia under the cor-

rupting influence of the Germans and of money. The first thing to learn is that freedom does not mean emancipation from all responsibility to others. It means the self-control that permits reasonable surrender to the needs of all men. War has given America the dim vision of a new freedom. In the fall of 1914 no one would have thought it in any way akin to our Civil War, and yet we see it now in its true perspective as the great struggle for freedom, as the struggle for the union of all nations, so that war may never come again. Yet we must have no illusions. Rousseau's doctrine, that man is born free, is false unless the word free is defined in some better sense than that in the dictionary. Men are never free. From the cradle to the grave they have to yield, and every individual lacks freedom in just the proportion in which he has to learn to live with other people. He must think of the wishes and the interests of others. When he has learned how to surrender himself and has learned obedience to the law, then he is truly free. Freedom is no more a natural inheritance than flying or riding a bicycle, but it must be learned if it is to be of any value in a republic. It demands training, hard discipline, self-sacrifice in daily life, especially on the part of those who are chosen to transact the great business of the nation and to lead in the maintenance of our democratic government.

Another much misunderstood word is equality. In its distorted sense, it has encouraged that fatal kind of socialism that would permit no individual to stand out from his fellows in mental or material possessions, and it would eventually kill any form of government; for a nation grows great only on its inequalities, if they be not the type that set up false standards and destroy the soul. The true application of the word is found in opportunity. We are equal, and we ought to be equal as to the opportunity to make ourselves mentally and morally superior. We glory in the greatness and superiority of Abraham Lincoln, and in that equality of opportunity that permitted him to go from a log cabin to the White House. Our most important lesson, then, in connection with American institutions, is the meaning of the two words "free" and "equal." Only when every man, woman and child understands them will democracy be safe.

I venture to state that only a small fraction of the people in the United States know anything about the growth of the Constitution or the reason for adopting the articles fixing a definite relation between executive, legislative, and judicial functions. The Supreme Court has been called the greatest instrument for free government in the world. Why? The most powerful element of citizenship is found in the answer to that question. It involves obedience to law, respect for judicial decisions, and the supremacy of reason over brute force. How many of our citizens grasp the significance of this in the training for public as well as private virtue? It is second only to conscience in the making of good citizens and an atmosphere in which the public can be properly served. The two, conscience and civic education, create the kind of patriotism that would lead a man to refuse a public office for which he had no training. Such a thing as a cabinet officer's resigning because he turned out to be a misfit is unheard of, either because we have not learned what a misfit is, or because our people have not been taught what to give of themselves and what to demand in Washington.

The third element of citizenship is found in true history, not that garble of victories in war, calculated to fill the breast with false pride that cannot see over an imaginary wall surrounding county, state, or nation. Germany is a victim of exaggerated ego, because her historians and writers have totally misrepresented the place of the German in modern life. God has not selected any nation for the dominion of the world. His laws undoubtedly have established ideals that dominate humanity, but never for the purpose of surrendering to some brutal ruling-class domination over men. Bad history, then, may promote bad citizenship. The history of our Revolutionary War usually emphasizes Bunker Hill and Yorktown at the expense of a proper perspective of the tremendous struggle against autocracy and the divine right of kings culminating in the French Revolution. We were fighting against George III and his Germans from 1776 to 1783, and the Declaration of Independence probably had more friends than enemies in England. The outcome of the Revolution was in the interest of democracy for the entire Anglo-Saxon race. It remains to be seen whether this war is the final blow to the old system or not. We might paraphrase Lincoln's words by saying that the world cannot longer exist half democracy and half autocracy. We must smash the autocracy in order that the world at large may recover a conscience and nations may hold a true and wholesome relation to one another. This is why history should be more carefully written and better taught in our schools.

A fourth element toward the foundation for public virtue in office is the education of foreigners in true Americanism. There are millions who must be turned into the kind of citizens found in the old colonies, the men who laid the successful and enduring foundation for free government. Could the American Constitution be written now? Have we the public men capable of striking off such a document? I believe we have, and that many of them have been created out of the children of foreigners. Through our workshops and our schools, and through associations, we should teach ideals of citizenship. This is more important than importing into the United States great examples of art in Europe. The statue of Frederick the Great, set up in front of the War College in Washington, is not a good example of citizenship. His system has ended in teaching good men that brutality is better in the will to force their *kultur* upon other men, than gentleness and love, and his work must all be undone if our conception of human freedom is to be extended over the whole earth. The perpetuation of German or other foreign societies in America is unthinkable, and we ought to break that down in one way or another. Usually the peaceful education of children in our public schools is the best method of proceeding. But we have not done enough by other methods. There should be a great organization within the United States for Americanism, and it ought to be used to counteract all other influence by public speaking and by a more effective propaganda than the Germans can ever again set up in America. This is the melting pot, and it is our duty to make sure that, when the whole mass is fused, it remains an American democracy firm in its convictions and in its demands on public service.

## WHAT IS PUBLIC SERVICE?

What is public service? Almost everything we do that brings us into contact with our fellow man is public, and we are likely to be too narrow in our definition.

Our relation to the government may roughly be divided under four heads:

1 The civil routine or conduct of business in government
2 Civil research and publicity for the benefit of citizens
3 Military training in peace
4 Military training in war.

### THE CIVIL ROUTINE OR CONDUCT OF BUSINESS IN GOVERNMENT

This necessarily includes everything relating to the administration, Congress and the judiciary. It is remarkable how little appreciation our people have of government business. No firm or corporation could exist under the present system in every department at Washington. In many cases the appointments, even when based on civil-service examinations, have not sufficient reference to the work to be done. In the higher offices, like the men who constitute the cabinet for the advice of the President of the United States, it is often only by chance that a man well fitted for the position is appointed. The War and Navy Departments may be included under the civilian departments so far as the secretaries and the clerks are concerned, and it is the rarest thing in the world to find, for instance, the secretary of the navy who knows anything about his business. Many million dollars and four years' incumbency are usually required to educate the man in office, and at the end of that time he goes out. Even though a few of the cabinet officers may fit into their positions, fewer still have any knowledge of government or the science of government.

When we come to the legislative branch the matter is even worse, because men are elected to represent constituencies on issues that have often no relation whatever to the transaction of the government's business. Congressmen when elected have their principal interests at home and very generally do not feel under any obligations whatever to make a study of government. Their votes are cast too often without knowing anything about the subject on which they are voting. It may be said that this is also true of legislative assemblies the world over, but it ought to be better under a democracy that throws responsibility on the individual, the responsibility for fitness and for citizenship. The lack of conscience in connection with our legislation is often disclosed in the Congressional joker. A bill that has passed the House of Representatives and the Senate may go to conference on some differences, and there have inserted by some congressman either without intelligence or without conscience certain things that were never in the original bills and never had been discussed. In our appropriation bill there is wholly a lack of system. Attention has been called to this time and time again by men who have held high office and are well acquainted with our methods. Millions of dollars are squandered because there is no budget and no plan, just as millions of lives may be lost through the failure of concerted action by the Allies in this war.

Another feature of this shows a lack of understanding on the part of our people or a lack of enterprise on the part of the engineering profession. A very large part of the business of this country relates to industries, transportation and engineering enterprises, and yet there is hardly a man in all Congress who has any grasp of the engineering matters. The curious part of all this is that our Congress does not know that it doesn't know. What would be self-evident to a scientific man must be beaten into a congressman by means of a trip-hammer, and yet our people put up with it.

We have every reason to feel confidence and pride in our judiciary, so far as the Supreme Court judges of the United States and of the states are concerned, but the courts have already been too much criticized by their own judges and lawyers to render it necessary for me to make any explanations whatever on the lack of training for doing business. Many cases have been known to hang on for years. Trials that should have been dismissed in two days have been exploited before the public for weeks. The Thaw case that was tried in New York was a disgrace to any community. The newspapers without public conscience at all published broadcast the most nauseating details calculated to satisfy only a morbid curiosity or to degrade the moral and literary taste of our youth. The difficulty with this is that the courts permit it to continue on the grounds that the newspapers publish what the public wants, the same grounds that would permit the sale of poison because the public wants poison.

### RESEARCH AND PUBLICITY FOR THE BENEFIT OF CITIZENS

In our scientific departments of the government, we have in a way emancipated ourselves from the accusation of inefficiency, although much useless stuff is published. The Bureau of Standards, the Agricultural Department, the Geological Survey, the Bureau of Mines, are unquestionably helping to educate our professions, our workmen and our farmers into higher efficiency. The men appointed to office under these different departments are usually well-trained men. They can naturally be classified by some kind of civil-service examination as the men in the business departments cannot.

Every state and every community unquestionably feels the effect of what we may call publicity at this time. The food-conservation program carried out by a mining engineer is really creating a revolution because the American people have been exceedingly wasteful and they are learning now something of the moral effect of saving. Mr. Hoover is only an instance of what can be accomplished by putting a trained man at the head of a department. Mr. Scott at the head of the War Industries Board and Mr. Coffin at the head of the great industrial survey, were other examples of what our profession may contribute to the success of the government. Too often, however, the profession of engineering does not realize its usefulness. We belong to all departments, those of business as well as those of scientific research, but it is the latter that claims us and we should be ready at all times, for this our highest function in the service of the people. Few engineers confess themselves able to speak on engineering and governmental subjects. We hold a duty to this republic, and we ought to fulfill it by learning.

### MILITARY TRAINING IN PEACE

One of the most astonishing phenomena in modern times is the ease with which the conscription bill passed Congress and the extreme ease by which it was enforced. Practically no objection has been raised except by a few malcontents and crazy people, and, yet, a few years ago no one was ready to listen to the words *military training*. Perhaps the speakers or the subject emphasized the words too much and gave the impression that they meant a large standing army, which we shall never want. If there is to be service in war, the whole nation, every individual, man, woman and child, must share in the sacrifice, and must be prepared. The hiring of volunteers is no longer moral. Only time will indicate how much we owe to Leonard Wood for his untiring effort to wake up the country to the importance of military preparation. The whole matter of training officers has been formed directly around his Plattsburg camp, and it is not too much to say that the training of all our men for service abroad is based on his theories. We listened too closely to the politician a few years ago and we have been fed up with three or four thoughts that would destroy the discipline and the correct reasoning of any nation if that nation believed them. The springing to arms of a million men in a single night is that peculiar kind of idiocy that is accepted in the remote agricultural regions where

ignorance of history is the dominant note. We engineers are not too proud to fight. We do not want peace without victory. We were not kept out of war and we do not want to be kept out until little Belgium has all that belongs to her again, all except the dead and the virtue that has been outraged by a brutal soldiery. I have never been a believer in the German system, because it gave too much control into the hands of a comparatively small number of officers constituting the German general staff. The idea of service beneath that system is, however, good. It makes for the education of young men and for obedience to law. Our country is not built up on the idea of obedience to individuals. It should, however, learn that liberty is based on law, and can never be anything else. It is hardly necessary at this time to dwell long on military training in time of peace. We have had our lesson and we shall probably never go back to the old system of a small standing army and a smaller militia of more or less efficiency, usually less. The conception of public service has been drilled into the people by stern necessity to maintain the liberties of the world, so that we shall probably have some kind of military training long after this war is over. Everyone has noticed what a difference the camps make in the slouchy individual who enters, to come out the trim, erect soldier.

The old pioneer days when every man was trained to use a musket have long ago passed, except in a few places not yet settled. We cannot possibly depend on the initiative of communities to teach our boys how to shoot and in fifty years from now a gun of any kind will be as little understood as the archaic engine put into operation by James Watt. Consequently, we must necessarily have some artificial methods of teaching the youths how to shoot and how to act in coöperation with other young men.

Military training is probably the best method we have of Americanizing the young men who come to us from foreign countries, and every one of them ought to be required to take his turn of service. It is not necessary that a foreign citizen making his home here, should be required to bear arms against his old country, but he should, for the sake of teaching him American ideals and American institutions, be obliged to take his place in the camps with young Americans, if he is permitted to make his living on our soil. The simplest of military training is learning how to keep step and that is a great moral influence. We need it beyond everything else in this country, where the forces are so pronouncedly centrifugal. Keep step! That does not mean that the men have to think alike. It does mean that they must act together for the good of our country, by a willing obedience to the control of men selected to manage the affairs of government. Keep step! The great leveler between the rich and the poor who must work together, whatever their homes may have been. It is the great simplifier of human relations. Keep step! The collective action that will put our public servants into a higher standard of training and education for their job. Keep step! There is nothing more inspiring, more beautiful than the march by of an American regiment. There is no goose step about it. It is the free swing of a free people that will never be trammeled by military dictation.

### Military Training in War

This nation already has that definitely planned out and our conscription bill has called many thousands to the colors. The selective feature of the bill has been more or less lost sight of, and its spirit has been violated up to the present time. Selection on June 5 amounted simply to a lottery method of choosing men for the service and little attention was paid to selecting them for special positions, in such a way that an army might be formed most quickly. Our young men are graduating from the schools, colleges and technical institutions. Many of them have a training similar to that found at West Point and Annapolis, but comparatively little use has been made of this fact. There are new training schools established that will eventually turn out men for specialized service, but here are, and were, many young men all ready for special service flung into the ranks. We have had warning of this in the mistakes of England at the outset of the war, and we have done nothing about it until now. One of the very curious anomalies in connection with even temporary exemption, is found in the recognition of the special importance of dentistry and the study for the ministry, while the industries have been recognized only so far as their workmen are concerned. If the present system is maintained, our engineering colleges are going to disappear in a comparatively short time, and the government will have to set up special schools which will take years to fit men for the places that the engineering schools can fill. Training in war is very quickly seen to be the heir of mistakes in training during peace. Inasmuch as we had no training before this war came on, we are heir to nothing and all of it will have to be learned.

The most serious part of this whole business is that training in time of peace is of no use whatever unless something is done about a supply of munitions and weapons to be used in time of war. In that respect we were worse off than any of the belligerents except little Serbia or perhaps little Portugal, whose standard we just about reached at the outbreak of the war. That is what rising over night with a million men always means in the mouth of those ignorant of history, even though they be in high places.

### Need Greater War Publicity

The training for the present war has a very important corollary that we seem for the time being to have lost sight of. A press bureau is established in Washington for the dissemination of information and its duties have been too narrowly defined. We need now extensive propaganda on what we are actually fighting for. The President well stated the case in his reply to the Pope's proposals for peace, but the people know only the call for troops and for money. A few pacifists and their friends, the German traitors, are concealing the great moral issue behind this business. We must have concerted and widespread publicity of a more penetrating kind. What do the Central powers stand for, the Prussians, the Germans, the Hungarians, the Bulgarians and the Turks? They are all banded together under the compulsion of the Prussians, whose ideas of war as a good thing and brutality as the justifiable method of striking terror into the rest of the world are wholly abhorrent to us. Their success means our failure and we must bring this home to every American, instead of taking things placidly while the German newspapers are fooling the public. We must, as engineers, carry back home the determination to awaken the country whether we are organized for that purpose or not. Every bit of camouflage should be torn off so that we Americans can see the vision of death beneath it. The old Persian proverb, "He that knows not and knows not that he knows not, he is a child, teach him," tells us the daily work of all our spare moments.

As part of the general publicity we must dwell on saving for the war. Economy in food, fuel and clothing is the moral duty of everyone. One of the saddest sights in an American

community is the organization of merchants to tell people to go on in their former mode of life and to buy. Carry this idea to its logical end and we shall lose the war. Prosperity has not come. All boosting of prices is blood money, and the men who are taking advantage of the country's need will be tainted all their lives. One of the most necessary distinctions in business is the priority of essential industries. All unessentials must go and all excess profits must be saved for the success of the country in war.

### ENGINEERS MUST KILL CONSPIRACY

The twentieth century is still young, and we do not yet know what it will represent to the future historian. Will it be the debauch of science or will it mean a new birth to Christianity? It is our task to decide this. There are two tendencies; one toward greater comfort and luxury, and one towards greater service. The first can plunge us only deeper and deeper into war for the control of a commercial output. It can only bring us more firmly under a governing class derived either by birth or by commercial success. The second means the complete emancipation of the individual trained to think of service as the chief source of good government and happiness in life. The only theory that will hold men together is that of service. All others, like the control, for instance, under an overlord, are but the cracked shells of old doctrine. This war is their last stand against a modern world, and our work as engineers and citizens is to help prepare for the new day when the rule of kings shall have been swept away. Our profession has been morally responsible for America under the century of invention just passed, as it is we who have created the applications of energy and it is we who have given the wealth of the world into the possession of a few men. This war will create many millionaires. It will place vast power in the hands of the strongest and most ruthless. It will strengthen the trade unions into autocratic groups defining what each individual shall be permitted to do, and what wages each shall receive. Are we to stand by and accept this? Are we to remain forever blind to our own power? There is only one answer to that. We must, as engineers, go forward with our own countrymen to kill this conspiracy against freedom and, then, we must give our lives to fight, that science may never again be employed as a destructive agent in the hands of a few unscrupulous men.

### WHAT CAN OUR SOCIETY DO?

What does our Society stand for in the scheme of this world's affairs? We know that there must be more or less selfishness and there will be often a great difference in the general fundamental principle underlying organization. Coöperation may have as its motive one of two ideas; first, the desire to benefit others, and second, the desire to benefit the organization. Sometimes it is difficult to classify under either of these, as the benefit to an association is often benefit to the public, in lifting the general average. And yet when things are traced back to their origins, it is possible to place most associations in their true category. For instance, the missionary societies—and we may with equal propriety say the churches—are altruistic in their origin, and, in the main, they remain so. Charitable organizations, hospitals and colleges are unselfish, and grow out of a sincere desire to give one's self to the service of others. Our own Society belongs to that class which benefits others as it benefits itself, for it is essentially educational in its purpose. As the years have passed, we have come nearer and nearer to a true conception of what our public relations should be, and this war has brought about a sudden large vision of our duties. They are not to be found in reforms put forward by the weak, or by self-seeking manipulators of public opinion, either within or without our Society, but rather through a state of mind. We owe it to our country to think clearly and rightly, and to throw the whole weight of our Society into the scale for sound legislation, good government, and public conscience. The engineer's philosophy is shown in his actions rather than in his words, because he has never learned to explain himself. It is expressed in the desire to serve. No profession can claim a higher motive than the silent men who fill our ranks.

We believe our Constitution to be the best instrument of government ever produced, and that under it all mistakes and imperfections tend to correct themselves. Our advantage is that conspiracy can never thrive, and there can never be a policy fatal to other nations. We can discuss any question of national policy and we can always have publicity against any hurtful tendency. The newspapers have always exhibited a high degree of patriotism when the need comes for discretion, and we may depend on them in times like this to stand behind every program for the good of our country. However sensational the headlines may be, we know that behind them is always a sincere desire for the greatest good to every citizen. Whatever our faults may be, they are always in the open and, like bacilli exposed to the sunlight, they die. That is, after all, the reason why a republic or some form of democracy is always superior to an empire under a few men.

Our country is the home that we love and, as engineers, we must feel a deep responsibility for its welfare. It is given into our hands by our forefathers and we know its virtue, and, God willing, we shall strive to make it the perfect example of what life on this planet shall become when wars are past.

## THE ENGINEERING SOCIETIES IN THE NATIONAL DEFENSE

BY GANO DUNN, NEW YORK, N. Y.

ENGINEERS are, indeed, coming into glory and honor—glory in the things we were reading about in yesterday's and today's papers, as to the behavior of the very men which our national engineering societies recruited in New York through the agency of the Military Engineering Committee only a few months ago, and honor in the ways that were referred to by your president in his address in which he mentioned the fact that the engineering profession and the corporate societies representing them are having an ever-growing opportunity to do their bit for the Government at this critical time. The spirit, the intelligence, the usefulness of the engineer is a matter of common comment. I have talked with several university presidents who remarked upon the high percentage of enlistments and volunteering for service, particularly of the men in the engineering schools, and Dr. Hollis has not exaggerated the part that engineers are playing, and are yet to play, in respect to the things in this great war which we have only just begun to appreciate and understand.

I should desire this morning to bring to your attention some of the things that are now being done by engineers and engineering societies. Adequately to treat of what the engineers are doing would take days, if not longer, and I can only refer to it. One has only to be in the atmosphere of Washington a short time to see that the whole Government of the United

States in respect to its military and naval preparation rests upon a foundation of engineers.

My task is encyclopedic, and I beg your indulgence if I but hastily skim over it. I wrote to the representatives of thirty-two different engineering bodies that are now in contact with the Government, asking them to give me authoritatively, although briefly, a résumé of what they were doing in connection with the national defense and with the war. It is beyond our time for me even to go through the replies, but I hope to put them in the record, and they are certainly a scroll of real honor to our credit.

To begin with, there is the Naval Consulting Board. The Naval Consulting Board was intended to bring formally to the service of the Government the scientific and technical ability of a group of the best advisers on engineering lines in the country, and the Government had the conception that if it asked the engineering societies to select these advisers the selection would be better made than if it itself attempted to make the selection. Consequently, two representatives from each of the different engineering bodies were nominated, and under that nomination appointed by the Secretary of the Navy, and that board has been doing able service since the time it was appointed, starting with the Committee on Industrial Preparedness, which took an inventory of all of the industrial resources of the United States. Later it proceeded to report to the Government on the needs of the experimental development of improved devices, and finally it established connections whereby its services might be made available and useful to the Army as well as to the Navy.

It now holds an honored position in Washington, where it acts as a Board on Inventions, and substantially all newly invented devices that are brought to the attention of the Council of National Defense, through various channels, are now referred to the Naval Consulting Board to be passed by, or turned down if they are not useful, or given attention if they are valuable. The Naval Consulting Board has offices at 15 Park Row, in New York City, and has a large force of clerks. The devoted services of its members are constantly given to going through thousands upon thousands of suggested devices from engineers, citizens, and others all over the country.

The Naval Consulting Board was created long before the war. The next body in order was the National Research Council. The National Research Council was started because it was seen that, just as in the Civil War, such help as was given by the National Academy of Sciences, created by President Lincoln, and is now being given by the national engineering societies, would be again needed. The Government acted, therefore, under the Charter of Congress granted in 1864 to the National Academy of Sciences, among the provisions of which were the requirements that the members of the Academy who then represented what we now represent, the engineering as well as the scientific intelligence of the country, serve the Government on request, in whatever direction called upon, without compensation. And they did an unusual amount of service at the time of the Civil War.

Between that time and now, entirely aside from their scientific functions, they have reported on about sixty different questions to the Government. It was seen that this body could be made of great use at this time,, and consequently President Wilson requested that it enlarge its scope and bring itself, as it were, down to date, and include the increasing branches of science that were not known in the old days, including engineering, and to do everything to put at the service of the Government the scientific talent of the nation.

In accordance with this request the National Academy of Sciences organized the National Research Council which may be described as being partly a federation and partly a creation, through which there comes to one single focus every important scientific agency in the United States. It reaches the universities, it reaches the industrial laboratories, it reaches the engineering societies, it reaches the isolated workers in pure science, but the keynote of the National Research Council is science rather than engineering, and engineering plays a part in it only as it deals with pure science aand applied science, in short, what we call engineering research.

When the war broke out it was only natural that the Council of National Defense should request a connection to be made between that body, which had existed for nearly a year, and itself, and since the war the National Research Council has almost dropped all other activities and directed its whole efforts to the problems in science that have been handed down to it by the Council of National Defense.

The next body in order of creation was the General Engineering Committee of the Council of National Defense. When the war broke out, our Society, in common with other engineering societies, immediately, and with a patriotic devotion, offered the services of engineers to the United States, directly to the President; and I do not think any of us realized at that time just what we were offering—quite a little confusion has arisen since as to what it was, but I do know that when we made the offer we did not intend to limit it merely to our engineering service, but we meant to go to any lengths that might be necessary.

Later on it came to be obvious that through this offer to the President we had not intended to convey the offer of our military services, and among other things we all remembered then that we were members of an even greater society than The American Society of Mechanical Engineers, we were members of the Society of American Citizenship, and that through membership in that greater society there came to us calls for military services and other things, and consequently the offer to the President of the services which we made through our Society was regarded as conveying only the offer of engineering service.

The President turned our offer over to the Council of National Defense, and from Dr. Hollis Godfrey of the Advisory Commission of the Council, an invitation was received to appoint representatives to form an Engineering Societies' Section of the Engineering Committee of the Commission. The Society acted officially upon that invitation and sent representatives to a conference in Washington, who met together with representatives from other societies.

From my point of view, this General Engineering Committee as it stands now is the official connection of our societies with the National Government; but the spirit among the engineers who want to serve the Government in more ways than this Committee renders possible, has caused the springing up on all hands of numerous other committees. I am going to read to you a list of the committees of engineering bodies which were in existence at a time, a short while ago, when outwardly and from the point of view of the Government there seemed to be so many committees that they were crowding each other, overlapping, and in their actual relations to the Government carried with them a certain degree of possible confusion, which was brought to our attention and which some of the members of our societies have been endeavoring to remedy.

These committees or engineering bodies are: Naval Consulting Board, American Engineering Standards Committee, Engineering Committee of the National Research Council, Com-

mittee on Gas and Electric Service, Emergency Construction Committee of the War Industries Board, the Intercollegiate Intelligence Bureau, the War Committee of the Technical Societies, the Engineering Council, the American Engineering Service Committee, the Aircraft Production Board, the Aircrafts Standardization Committee, the Aeronautics Committee of the National Research Council, the United Engineering Society, the Engineering Foundation, the American Society of Civil Engineers, The American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials, the American Society of Automotive Engineers, the American Electrochemical Society, the Illuminating Engineering Society, the American Chemical Society, the American Gas Institute, the American Society of Refrigerating Engineers, the American Water Works Association, the National Electric Light Association, and the Association of Edison Illuminating Companies.

The mere enumeration of these engineering bodies itself is a bright light on what the engineers, as societies, have been doing for the Government. It does not begin to be a token of what engineers as individuals are doing for the Government.

As societies, however, there has been some confusion among the various societies, due to overlapping, and there has been also some lack of distinction between engineering services on the part of individuals and corporate services on the part of societies. For instance, one of the great services which no single individual could render the Government, but which a union of societies could wonderfully render the Government, is the question of engineering personnel. So great has been the demand in Washington for competent engineers for this, that and the other service that they have not known where to go to find the men. They first went to their personal friends, to the members of the engineering profession already in the departments, and to those whom they were acquainted with, but soon the supply of acquaintances of these men and the men with whom they were in contact was exhausted, and the authorities were simply at the end of their capacity.

It has been very obvious that at least one of the functions that the national engineering societies could perform was to serve as a center to which the Government could go and find an adequate roster properly classified of all of the men who could render service to the Government, so that the services of these men promptly could be called upon. Through a misconception, the responsibility for which I will not attempt to go into, the General Engineering Committee, which, as I have said, in my view is the official connection of the societies with the Government, declined to furnish the required roster of the personnel. I ought to say that it declined to do it on the recommendation of its chairman, Dr. Hollis Godfrey, who at the time was under some instruction from another branch of the Council of National Defense, which had in view the classifying of engineering service or labor generally, and consequently had in view the grouping and listing of this service in another department of the Council of National Defense, where it was hoped there would be a much broader and more general listing of labor than that which we now usually consider as labor, but be it as it was, the General Engineering Committee declined what, in my opinion, is the principal opportunity to be of service to the Government.

There then sprang up the Intercollegiate Intelligence Bureau for the purpose of making good this deficiency to a certain extent. Its origin was not in the engineering societies, but through an engineer, one of the prominent members of the American Institute of Electrical Engineers, Dr. William McClellan; he organized 170 colleges into a sort of league to supply to the Government men of technical training and engineering qualifications. He went at it through the colleges, because he is president of the Wharton School, and also because he felt that through them he could get in contact with a greater number of engineers and could accomplish better work than in the other direction.

The Engineering Council, which is a body destined to represent not only the great national engineering societies which are members of the United Engineering Society, but all of the great national engineering societies, also took up the question of personnel. It conceived its function to be a very broad one and organized in an endeavor to make certain contacts with the Government, leading up to that through the Naval Consulting Board, through the National Research Council, and through the General Engineering Committee, and there was also created under the Engineering Council the War Committee of the Technical Societies, and also a committee known as the American Engineering Service Committee; Dr. Brunton is chairman of the former and Mr. Foran is chairman of the latter.

These committees went to work vigorously, headed by Dr. Hollis in the Engineering Council, and from the beginning have seen the importance of a registry of engineers and they actually started to accomplish a registry of that kind. When representations as to what these committees had done and were doing were made to the Government, and now speaking from my own point of view, and with the hope not of producing controversy, but of allaying it, the committees were not fully aware of what had been done already by the Naval Consulting Board, by the National Research Council and by the General Engineering Committee, all of which bodies had been in efficient contact with the Government, contact through channels that had been grooved more or less bright by use, and therefore the newer committees wrote to numerous agencies of the Government and interviewed them, and from the Government point of view canvassed the Government as to what channels they should use in their relations with these various activities.

The confusion that arose, although not serious, required straightening out. For instance, the National Engineering Society, as such, had nothing to do with the appointment of the National Committee on Gas and Electric Service. They were more or less unfamiliar with that committee and its work, yet of all the committees in Washington that committee has probably done as much as, if not more than, any other committee in specific and concrete service rendered to the Government. That committee is a committee representing public utilities, or rather it represents the Council of National Defense—it is a committee of the Council of National Defense itself—but it instructs them and knows about the public utilities, and so today is charged with questions of coal supply and of power supply, questions of keeping the industries going that are engaged in munitions manufacture, questions of cantonment inspection and cantonment supplies.

The gist of the matter was that a certain member of our Society, Mr. Swasey, the Father Abraham of the Engineering profession, was down in Washington and learned of some of these things. He endeavored to bring about coöperation and understanding among the thirty-two different engineering agencies. He called a meeting of the representatives of these organizations, and they all most promptly responded and met in Washington. That meeting was an eventful one in the history of the relation of the engineering societies of the

country to the Government, for the knowledge was there brought out of the vast amount of service that was being rendered to the Government by engineers, and everyone present at that meeting was astounded at hearing how much everyone else had been doing, and the mere getting together of these committees is a thing that is going to solve the temporary and minor difficulty of a unified relation of the engineering societies to the Government.

For instance, at that conference we heard the representative of the Society of Automotive Engineers say what his committee had been doing. That Society has been intensely vigorous—it has been of actual, concrete and real service to the Government in a way that cannot be known; in fact, one reason why the members of the societies have felt impatient at their Washington relations is because the work, as such, cannot be dwelt upon in detail among them. The Government requires that almost all the work of these various committees and societies be confidential and shall be kept to themselves, and that is one reason why the membership of the Societies have felt that they were not doing their bit, when in fact they were doing all that the Government so far had called upon them to do.

The status of the matter at present is that that joint meeting in Washington appointed a sub-committee to confer with the Engineering Council and with the governing bodies of the national societies, with a view of reporting back some general plan whereby the chairman of the War Board, for instance, would not be receiving four different letters from engineering bodies, each inviting him to take up problems of a certain kind through that particular committee. It is confusing to that chairman to receive such letters, and moreover it shakes his confidence in the ability of the engineers to organize their work effectively and to do the things that they most want to do.

I am afraid I have omitted ninety per cent of the things I wanted to say in regard to the activities of certain of these committees, and I perhaps ought to speak about the War Committee of the Technical Societies. That committee was intended originally to be a vehicle of information between various Governmental activities and the membership of the national societies. It was intended to be of service both ways. It was intended to satisfy this demand on the part of the membership by knowing as far as possible what was going on. It has recently established a connection with the Naval Consulting Board, and the general view of the engineers now interested in the Washington relations is that there never can be too much service in Washington, and that there is room for every committee. Colonel Carty, who presided over the conference called by Mr. Swasey, said that the whole thing is too big to be controlled by any one committee, and it is realized that the more there are of these committees that represent real service, the better it will be, and all that is needed is a little better directive force and a little more inquiry and coöperation before taking up with the Government questions that may have already been settled, in fact, by other agencies.

The situation as it stands now is one in which we may all take great pride. The General Engineering Committee of the Council of National Defense is in the awkward position of being asked by its chairman to resign. This is through, as I understand it, a fancied conclusion that service on that committee is incompatible with the ruling of the Attorney-General to the effect that men may not serve on committees of the Council of National Defense when they have other business relations with the Government. The business relations of the men in the engineering profession serving the Government are so numerous that if that principle were really carried out in fact, the Government would be deprived of the service of engineers; or, on the other hand, the industries, the engineering projects, and the very great works that are now being accomplished for the Government would be robbed of the directing heads that are producing them. Neither of these alternatives is for a moment conceivably possible.

This opinion of the Attorney-General has been interpreted by the Secretary of War to mean that no man may sit on a board in Washington when that board is engaged in deliberating upon the award of a contract to a company in which that man is interested. That is only common sense. It has gone one step further, and says that no man may sit on a board when that board is making recommendations to another board, which other board may be empowered to award contracts, except, in this case, the man is not forbidden to sit on that board, but if he sits he must file with the second board a statement of his complete relation to the contract that is under consideration, and state what other interests he may have with it.

I think one reason for the general resignations that have occurred in the Council of National Defense has gone a good deal further than this technical situation. The Committee has been overgrown, overgrowth indicating rather a lack of authority, which the springing up of so many committees always indicates. The authorities wanted to reorganize the whole matter, and certainly that reorganization is now in force, but whether it will take the form of continuing to ask for the resignations of the members of the General Engineering Committee of the Council of National Defense, or whether that committee can be regarded as an exception, because it is a non-commercial committee, and whether that committee can be permitted to retain its relation there with the Advisory Commission, or establish new relations directly with the Council of National Defense, the same relation that has been established by the National Research Council, is not yet to be known. However, whatever it is, the principal thing which is now to be settled is not the relations of the twenty-eight of the thirty-two committees, whose names I have read; their relations are very satisfactory; they are doing splendid work for the Government; they are a credit to the societies that have created them and the men who are in them. They are one of the good right arms of the authorities in Washington. Any confusion that may have existed lies in respect to the relations of the engineering societies, as such, to the Government; in other words, our own corporate relations to the Government for those things which we as societies may do, which we as engineers do not do, and under the leadership of Mr. Swasey that general question is now being happily and kindly worked out and thought out in a way which will result in the Government continuing to get not only the service it has been getting, but such increased service as the near future will lead it to demand.

We are not yet really in the war. Times are coming—they are predicting it in Washington—when the service we have so far rendered will be like but a little cloud on the horizon. Our duties will increase; our opportunities will increase. I do not think the patriotism of the engineering societies can increase. It has been at par from the beginning.

But, gentlemen, those of us who felt that because they were not yet called upon they were not going to have a place in this great war; those of us who have felt that because of some defect in the machinery at the top they were not being put in touch with the things they could do; those of us who have felt that way, I think, will soon, and very soon, have a

call for everything that they can render. In Washington, the views of the authorities are all in one accord as to the patriotism, the usefulness, the distinguished service and the ability of the engineering societies and their representatives in the national service. We have been a credit to ourselves in a big and fundamental way, even if some of our superficial relations have not been quite as orderly as we might have liked to have them. I have been told there is not yet on record a single case where the Government has actually asked an engineer to do a service for it where he has not responded, and that is a badge of honor which for our profession I hold very high.

## SPECIAL EDUCATION IN TIME OF WAR

BY DR. CHARLES S. HOWE,[1] CLEVELAND, OHIO

I AM asked to talk to you about some of the problems facing the engineering colleges. These problems are definitely connected with two questions, which I do not propose to discuss at any length. The first is: Does the country need engineers in time of war? And the second is: Have we enough engineers now to supply the need during the war and after the war is over?

It would be needless to mention these questions were it not for the fact that if the present methods are carried out there will be no teaching in engineering colleges after a few months have passed, and the engineering colleges are the only places where systematic education in engineering is given. Engineering instruction is carried on to some extent in some shops, and very efficiently carried on, but there is no systematic attempt made over the entire country to give engineering education in the shop. Hence the colleges of engineering are the institutions to which we must look for engineers in the future if we need them.

It is surely not necessary for me to answer the first question after you have listened to the address of President Hollis and the address of Mr. Dunn, and it will be especially unnecessary after you have listened to the other speakers of today. I shall not attempt to discuss that question.

As to the number of engineers needed, it seems to me that all of you will agree with me that we do need to continue the supply of engineers, because we shall need more while the war is going on than we have now, and we shall certainly need them after the war is over. You have found in your business the drain upon the supply of engineers now. You know in a good many cases it has been difficult to get men for engineering work in the firms with which you are connected. We in the colleges know we cannot supply any of the engineers that are demanded now and asked for every day, that it is utterly impossible to send a man to any place unless we take some one who already has some position, and that the demand now is larger than it ever has been before, and we believe it is going to continue.

Therefore, it seems necessary to train engineers for the future. But the drain upon the engineering colleges has been very great. As soon as war was declared, it seemed as if every college student—I can speak only of the engineering colleges—wished to go into the army. We had very great difficulty in keeping any of them in the colleges. While they were determined to go, the members of the faculties were trying to keep them out of the army as far as possible, because it seemed to us that these boys who were being instructed to become engineers would be of more service to the country after they had been trained as engineers than they could possibly be as privates in the army. If the situation were more critical, if the enemy were at our door and every man had to shoulder a gun, the case would be different; but as things are now, and as the supply of engineers is limited, it seemed to us that we ought to keep these fellows in the colleges until after they had been graduated. But it was impossible to do so. They enlisted in every form of service—they went into the army, the navy, the flying corps, and the ambulance corps. They are carrying ammunition in automobiles all over the battlefields of Europe, and they are in every kind of service that the army has to do. They are going now in large numbers, and most of the engineering colleges have lost anywhere from twenty to thirty per cent of their men in the last year.

These figures merely include the number who would be trained as engineers and graduated within the next few years, but now, by a ruling of the War Department, young men have the privilege of enlisting up to December 15. After that date, if they are drafted, they must go into the service for which they are drafted. The result is that there is the greatest uneasiness among all college students. They are leaving our colleges in large numbers, and unless something is done to allay this uneasiness before December 15, we shall lose a large number of men who ought to go into the army as engineers.

According to the classification that has just been given out, college students will be in Class No. 1, and that class is to be exhausted before any other class is drawn upon. Consequently the engineering students will all be taken out of our colleges in the next draft unless something is done to save them for their professions. I would not at all say that the boys object to this—these fellows are young, they are full of red blood, they are interested in their country, they are anxious to have a hand in the struggle that is going on at the present time. They want to get into the struggle, and it is with great difficulty that we keep them out of it. But we who are charged with their training are trying to look at this thing in a cold-blooded way. We say, Are these men going to be needed for a special service? If they are, they ought to bear in mind that every man should look forward to the best service that he can render, and not merely try to get into some kind of service.

### PLANS FOR DRAFTED STUDENTS

The colleges, recognizing the difficulty before them, have tried to interest the War Department in the question of saving some of these students, because after the second draft is made there will be only those under twenty-one years of age—and not even those, if the draft age limits are changed, as seems probable—and those physically unfit.

You are all probably aware that the medical profession took up this question last fall, and that an act was finally passed which permitted medical students to enlist in the Medical Reserve Corps, and the men who so enlisted are not liable to draft, are not liable to be sent into actual service until after they have secured their degrees, and so the Society of American Universities has requested the Government to allow engineering and other scientific students to enlist in some reserve corps until after graduation. They have asked that chemists and engineers and physicists and bacteriologists and others pursuing scientific work might be allowed to go into one or another of the numerous reserve corps where they would, of course, be subject to Government control, but would not be called upon until after graduation. The authorities at

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Washington turned down this request. A similar request made by the Association of State Colleges, has not been acted upon as yet, but probably will be turned down, because it is similar in character to the request made by the Association of American Universities.

A request has been made by a number of colleges that students who are enlisted shall be furloughed back to their institutions. That has not been acted upon. It has been suggested to the authorities, I believe by army men themselves, that a certain proportion of engineering college students be exempted from the draft until after graduation. Some of us object very much to that word "exempted." We do not want our college students exempted from service. We want them in the army, if they ought to be there, by the draft, but we would like to keep them in colleges long enough so that they may finish their training.

Another plan which has been proposed is that engineering-college students who are drafted be detailed back as drafted men to the institutions from which they came, provided that when they were drafted they were in a state of proficiency in their work in the college so that it is reasonably certain that they can be graduated with credit to themselves and the institutions with which they are connected. A part of this same plan would be to have these men wear their uniforms and have it understood by all of the students that they were soldiers in the army, and that the colleges be required to give them military drill, so that they would not be losing altogether the training which they would have had if they had continued with the active army.

Another provision is that the colleges shall report the standing of these men to the War Department at the end of each semester, and any man who is not doing efficient work shall be immediately sent to his regiment. Another provision was that after graduation these students should immediately go to their regiments as privates and work up to positions as non-commissioned officers and perhaps commissioned officers, if they were competent for that kind of service and were needed for it.

It seemed as though one or the other of these methods would permit us to keep our students in college long enough to train them for the various branches of service and that then they could be sent wherever they were needed. The Government has seemed indifferent to the necessity of maintaining the supply of trained engineers. I think that is because they have been so busy with organizing the army that they have not been able to give any time to the question of training the engineers. I was in Washington last Saturday with a committee of another society and took up this question with the War Department. It seems from what we learned there that the War Department is greatly interested in this question and is now taking steps to provide adequate training for a certain number of engineering students. The details of the plan we do not know—and cannot know until the matter has passed through the hands of the Secretary of War, but it looks now as if some method would be adopted at Washington before very long whereby engineering students may go on with their training, just as medical students are now going on with their training.

[In connection with this it might be interesting to note that the A.S.M.E., through the Engineering Council and the Society for the Promotion of Engineering Education, has passed resolutions to the Government that the preservation of a source of supply of engineers be given careful attention. These resolutions have already been acted upon and provisions for drafted engineering students made.—EDITOR.]

### SPECIAL TRAINING DURING WAR TIME

Another question which has been before us is that of special training during the war. I think that all of the colleges have insisted on military drill as part of their work. Many of them have made this training compulsory, although it has been exceedingly difficult to secure army officers to take charge of that drill. Nearly all of the colleges which could not secure army officers have appropriated money from their own treasuries to pay for the services of men who have had experience as officers and who are not eligible for active service in the army at this time. Nearly all of the colleges have established some military-engineering work. For instance, they have taught the students how to build military bridges; they have taught them how to lay out intrenchments; how to make rapid plans of any region of country, how to do reconnaissance work; how to make maps which could be used by the army officers of any section of the country, and various other things connected with military engineering which are very desirable for any officer and perhaps for any soldier to know.

Work has also been given to some extent in the mechanical and electrical-engineering departments; that is to say, men have been trained in the application of electricity as necessary in the army. Some of us have gone to the military-engineering schools, where we have been able to find out just what instruction is given the army men in signaling, for instance, and in the use of searchlights, as well as in military telephony and telegraphy, and courses of study have been introduced in many of our engineering colleges to better prepare men for that class of work. The Chief of Ordnance suggested one day in Washington that the colleges give their students in machine design in the future the designing of heavy guns and gun carriages instead of the ordinary machine design, and offered to furnish blueprints which would form the basis of some of this work.

Some of our institutions will teach their chemists a great deal about explosives, giving them not only the chemistry of explosives but the methods of manufacturing the explosives. I do not mean that they maintain explosives factories on the college grounds—that would not be allowed—but they teach them the methods of manufacture, so far as they can, without actually manufacturing the explosives, and teach them the chemistry of all of the ingredients that go into the explosives.

Quite a number of professors of chemistry have visited the explosive factories in order to find out the latest methods in use in the manufacture and handling of explosives, as well as to ascertain the different materials that enter into them. So that in all these ways the engineering colleges are trying to give their students some information which will be especially useful to them in the army if they are drafted, or if they become officers in the army.

There is still another important question before the engineering colleges: If they lose all of their men over twenty-one years of age, except the physically unfit, and have left, therefore, only the freshmen and sophomores, the greater part of whom are under twenty-one years of age, is it necessary for them to change, or is it not advisable for them to change, their courses of study in order to fit these men for the actual things they may have to do after they go into the army? It has seemed to some of us as though we ought to do this; that is to say, that if we know our courses in the engineering colleges are to be limited to two years, that we ought to materially change our courses of study during those two years in order to fit the men for some of the engineering work which it would be possible for them to do.

In conclusion, I would say that the engineering colleges have tried to look at this matter in an entirely unselfish way. They are not thinking of the number of students they will have, or of any income which will come from these students, but only of the question of the most efficient way in which they can train these young fellows for service, and they are ready to do anything which the Government wishes them to do in order to carry out this plan.

## THE OPPORTUNITY FOR INDUSTRIAL RESEARCH

By C. E. SKINNER,[1] PITTSBURGH, PA.

THE successes of the past and the host of problems awaiting future solution should be ample proof that industrial research has before it a field of unlimited opportunity. There are many phases of the subject which might be discussed to advantage at this time, such as the extent to which industry should carry on pure scientific research, the extent to which different industries could pool their research interests, methods of attacking research problems, the education of research workers, the coördination of industrial, governmental and university research, and others. This paper will, however, be confined mainly to an attempt to show by illustration some of the opportunities which exist. Possibly no better example could be chosen than that of the study of alloys, and this should appeal to the mechanical engineer as no other single development has perhaps contributed so much to his progress in the last two decades. Machine tools have been revolutionized. There are few important machines today which do not depend on alloys for some of their vital parts. The automobile, the airplane, the modern locomotive, dynamo-electric machinery, and many others, would require changes much to their detriment if modern alloys were not available.

And yet, in spite of the work already done on alloys, we have explored but a fraction of the really useful fields. Few, if any, general surveys have been made of the possibilities of binary and ternary combinations, and such studies should yield results of great value. The subject might be attacked in either of two ways: first, by endeavoring to get at the fundamental laws governing the alloying of metals so that the results of making any particular combination could be predicted; or, second, by experimental methods actually making and testing a sufficient number of the alloys under consideration to give the data essential. The purpose of such a study may be to produce an alloy with certain desired characteristics for a specific purpose or it may be to determine the useful alloys possible from the combination of any two or more metals. The former may be relatively easy or very difficult, depending upon the requirements. The latter cannot fail to be anything but difficult and long-drawn-out, no matter what the method of attack. Let us consider briefly what such a survey means. It would be desirable to start with chemically pure metals, but metals chemically pure are practically unknown and often metals of a purity not at present commercially obtainable show characteristics very different from those commercially obtainable. For example, magnesium as ordinarily obtained is quite brittle, while the metal approaching chemical purity is very ductile. Tin of high grade combined with lead gives us a solder with well-known characteristics, while certain commercial tins now on the market carrying small percentages of bismuth impart to solder characteristics markedly different from the purer tin. Consequently natural impurities must be studied both as to their influence and as to their elimination. Methods for the preparation of the constituent metals with unusual purity must be developed. The differences between the effect of natural impurities and added impurities must also be examined, as these differences are sometimes very marked; as in the well-known effect of added sulphur as compared to natural sulphur in steel for certain purposes.

Keeping in mind the necessity for pure materials and the influence of impurities and alloying methods, we may assume that a series of alloys of any two metals is to be made varying in their proportions by 1 per cent. This would give us ninety-nine different alloys for each grade of each of these two metals. Each of these will require a large number of tests and repetitions to determine the various influences which may change their important characteristics, and each sample will require a large number of determinations to arrive at its chemical, physical, electrical, magnetic, thermoelectric and other characteristics. It may be necessary to study the effect of each natural impurity on each alloy of the series, which will multiply the tests manyfold. Those which promise to be commercial will require many further tests to determine their working qualities and adaptability to commercial uses. In addition to the above, it is well known that certain alloys have very sharp and very marked inflections in certain of their characteristic curves, sometimes within a range of less than 1 per cent variation in their composition, as, for example, the variation in the thermoelectric value of certain nickel-iron alloys which occurs at approximately 27 per cent nickel.

Such a study even of a single series of binary alloys would involve tens of thousands of determinations and much time and expense. If we add a third and a fourth alloying metal, it will readily be seen that a lifetime would be entirely too short to compass a full exploration of such a series. In fact, it is doubtful whether a relatively complete study of the possibilities of a single binary combination could be accomplished by any one in an ordinary lifetime. A very elaborate study of the single alloy, 88 per cent copper, 10 per cent tin and 2 per cent zinc, has been under way for two or three years, the leader in this work being the Bureau of Standards, assisted by a number of producers and users of this material. The Bureau has outlined over a score of characteristics to be determined and the work is as yet far from complete.

It may be argued that such an elaborate study would not be warranted even to give complete data, as many zones could be passed by as not promising or a few experiments at most prove that the combinations in certain zones were of little or no commercial value, but we are learning that where ordinary methods with metals of commercial purity fail to give useful results, other methods or purer materials may give results of great value. Unfortunately, we do not know the theory of alloying well enough to predict results with any certainty. We know of no theory to account for the fact that an alloy of 3¼ per cent nickel with iron has low permeability at low inductions and high permeability at high inductions, while an alloy of 33 per cent nickel with iron has high permeability at low inductions and low permeability at high inductions, and an alloy of 27 per cent nickel with iron is totally non-magnetic, except at very low temperatures. Or again, how shall we account for the fact that certain alloys of copper, aluminum and manganese, where all the constituents are non-magnetic, produce an alloy which is strongly magnetic, while an alloy of 12 per cent manganese with iron—the latter being our most strongly magnetic material—gives an alloy which is non-magnetic. Again, alloys of aluminum and tin, with or without

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other alloying metals, may make alloys with fine characteristics when first smelted, only to disintegrate to powder later. No satisfactory explanation for this action is now available. These phenomena are just as difficult to explain as the fact that two gases, hydrogen and oxygen, combined in a certain proportion give a liquid (water), while three materials, carbon, hydrogen and oxygen—the one a solid, the others gases—when combined in certain proportions give a resulting gas, in other proportions a liquid, and in still others a solid. The idiosyncrasies of certain alloys cited above show the futility of attempting to predict results with our present theoretical knowledge of the subject. It is probable that the necessary theory for a full understanding of the subject may come only from a study of the atom—its structure, its combination into molecules and the ultimate forms and characteristics which the constituent elements may take. A general solution will hardly be possible from a study of the chemistry or the metallurgy of the subject, but by a coördination of the chemistry, the metallurgy, the physics and the magnetics through the work of the molecular physicist. Thus the ultimate solution of a very practical industrial problem can hardly be expected, except through the work of the pure scientist. True, the patient experimenter trying to explore the whole field may furnish the facts to prove the theory conceived by some brilliant mind, which will make further drudgery in this line largely unnecessary.

The above example has been dwelt upon at some length to show the possibilities of unlimited research in what might seem from a superficial examination to be a highly restricted field. This is equally true in numbers of other fields. We know very little of the laws governing insulation and the theory of conduction in dielectrics. It is possible that the fundamental laws governing the characteristics of alloys may also explain some of the mysteries of dielectrics.

The examples cited illustrate another phase of the subject that may be emphasized to advantage, and that is the ever-widening field of any research, no matter how restricted in scope its object may be. The study of a single series of binary alloys may necessitate studies in the source and preparation of the raw materials, methods of smelting and alloying, a study of containers and molds for the molten metal, types of furnaces, temperature measuring devices, smelting and pouring temperatures, rates of cooling, effect of quenching, methods of forging, rolling and drawing, development of new test methods to determine new characteristics and many other phases of the subject. Totally new characteristics may be found by using hitherto untried methods; for example, alloying under extreme pressure or temperature, or both. If the worker is to understand fundamental laws governing the work which he is undertaking he must have a thorough knowledge of the chemistry, physics, mechanics and magnetics or he must have co-workers available who can look after such phases of the subject together with the necessary equipment for carrying on the necessary tests.

### Compares Nation to Alloy

If this country is the melting pot, then this nation is an alloy, an alloy infinitely more complicated than any I have described. What are the influences for good? what are the poisons? what evil influences can be fluxed off in the smelting? what will remain to vitiate the resultant alloy? what will be the result of the heat treatment of war? will it respond to the new treatment necessary after the war? What a research we have before us as engineers and citizens!

No paper on research today is quite complete without some reference to the war. Prior to the war some one decried research and scientific development generally, because of the possibility of their making war more horrible when war should come, and many felt that war would become so horrible as to be impossible. We must admit that much of the horror of the present world war which particularly appeals to our imagination has been made possible through our latter-day research and scientific development. We have but to refer to the submarine, the airship, noxious gases and high explosives to illustrate the point. It is doubtful, however, if any right-minded man would wish that all development through research should have been halted at any previous specified time, in order that the use of such things should be impossible. We would not give up our advances in chemistry in order that high explosives and noxious gases could not be used. We would not discard the telephone in order that the submarine could not be provided with listening ears. We would not discard our advantages in aeronautics in order to prevent the dropping of bombs on defenseless women and children. Each element of frightfulness based on scientific research can and must be met and conquered by scientific research. The agents of frightfulness and the means of overcoming them will become the means of restoration and reconstruction after the war. The "die is cast" and we must go forward with our research as never before, both to win the war and to provide for the readjustment necessary after the war. We are spending our natural resources at an appalling rate, but we must use the last pound of coal and the last drop of gasoline, if necessary, to win the war. If this be necessary, we must find other substitutes through research. The development and use of the internal-combustion engine has reached a stage which makes it impossible to think of the world after the war without internal-combustion engines, even though our present fuel for them be exhausted. Furthermore, the restrictions imposed by the war have taught us that many substitutes are possible where such substitutes would have been considered impossible or at least very undesirable before the war. Tin-base bearing metals were considered absolutely necessary for some services until the scarcity of tin made it necessary to use a substitute containing little or no tin, and this has been perfected until it meets every service equally as well as the genuine babbitt.

### Research Necessary to Win War

We cannot emphasize too strongly the two main points brought forward in this paper: first, the unlimited field open to research in every conceivable line of endeavor, and, second, the necessity of taking advantage of these fields both to win the war and to provide for the reconstruction and readjustment that must follow. Research can and must do its bit now. Research can and must be an important factor later. To meet these requirements we need workers trained in the fundamentals of all branches of science who can bring to their work the devotion, the enthusiasm, the optimism and the imagination so essential to success in any work and doubly so in research. We need the aid of all who can help in the training of research men. We especially need the aid of men with imagination who are in a position to furnish the funds, the equipment and the organization to provide that pure science and applied science shall advance in every possible way. It is not hard to show that industrial research through applied science pays. It should not be difficult to show that this depends on pure science and, therefore, that pure science should pay in every sense of the word.

# THE AGRICULTURAL PROBLEM

BY LIBERTY H. BAILEY,[1] ITHACA, N. Y.

*(Abstract)*

I AM here by telegraphic order, standing in another man's shoes to discuss his subject, yet without having his paper. All I can hope to do is to establish a point of view. If I were to make any statements on the place and office of engineers in the body politic, I should want first to attend their meetings for some time and also to associate with them in their professional capacity in order that I might see something of their problems in their public relations and also understand their own measurement of themselves. You deal with mechanical or physical forces. It is your business to handle these forces and to make them serve you in a large way. It is one of your problems to eliminate time and space as they apply to the ordinary man. You are dealing with large affairs, with persons in the mass, and with work that has distinct public relations.

There are those, however, who deal primarily with biological forces. The forms of life are adapted to the conditions in which they are placed. It is not necessary to inquire here what has been the process of this adaptation, but all biologists recognize as a starting point of their discussions that the animals and plants are adjusted to the conditions in which they live. Today I invite your attention to this situation, asking you for the moment to forget as far as possible the physical and mechanical relations in which you customarily deal.

## FARMER'S ATTITUDE IN WAR

Just now we hear much about the farmer's attitude toward the great affairs confronting us. There is considerable criticism. All the criticisms I have heard are projected from the point of view either of class organization or industrial organization. Those who would defend the farmer speak of his psychology and the necessity that the rest of us understand it. The result is that much of the treatment of the farmer is cajolery. The situation lies far deeper than psychology. Let me give you a formula:

"The farmer is part of his environment, matching himself into his background, perhaps unconsciously, much as a bird is matched, or a tree, or a quadruped. His plan of operation, his farm management, is an expression of his situation in nature: he has worked it out because it fits. He cannot shift it radically to meet the advice of any other person. As he himself develops in ability he will modify his plan of operation so far as he can, but the plan must always fit his place in the environment; no great change is possible unless his natural conditions change: he does not make his conditions. The farmer exemplifies, in the human range, what the naturalist knows as "adaptation." His situation does not admit of compromises, perhaps not even of adjustment, and therefore it may not be understood by teachers, publicists, officials."

## FARMER CANNOT BE PRESSED

The consequences of this formula, if it is true, are tremendous. All the advice given the farmer that does not recognize his necessary adaptation to his environment is useless; and useless advice is harmful. It is of no advantage to rail against the farmer any more than against the wind or the rain. It is idle to try to apply to him the pressures that are exerted on corporate business. It is of small consequence either to praise him or to condemn, to take sides for him or against him, except insofar as it may affect his spirit as a man. When, under pressure of great crises, we radically change the conditions under which the farmer works, we must allow him time to readjust himself: he must take account of the latitude that he may reasonably expect in weather and soil and human forces. He needs not favors, but conditions that will allow him to operate. The natural conditions within which he works cannot be changed, but they can be modified in some ways, and he can make new adjustments within certain limits; these possibilities he begins to understand, and they are parts of his problem as a farmer; when the economic or outside conditions are changed, the modifications must be such as will match the natural limitations, if he is expected to adopt them. In the present crisis our public agencies must understand and recognize what can reasonably be required of the farmer.

It is an old adage that appearances are deceitful. I wish to add that they may be misleading. Persons managing corporate, industrial, labor and professional affairs have a certain air and habit of presentation. The farmer operating his farm may not have this air. He has nothing to present. He may be following a plow in the back lot, unshaven, trousers in his boots, working until the work is done, even though the clock points to five. Perhaps he would not discuss politics or civics or religion, at least not till he knew you; but, good or bad, he has worked out the management of his farm, and he thinks he knows why. He will listen to your advice; then he will go on with his plowing. He is hard against facts—real facts, not paper facts; he accepts them and acts accordingly. You may not like him, but he himself is a fact.

## ATTITUDES TOWARD FARMER RIDICULOUS

Bearing in mind these fundamental considerations, established in the nature of things, some of the popular attitudes toward the farmer become ridiculous. I was out of the country when war was proclaimed, but I understand that everybody who had a public voice fell to advising the farmer. This is futile, since the farmer is the one part in the population to whom advice of this nature is of no value, and for the reason that it cannot be applied. I am sure that much of this advice made no account of situations that neither the farmer nor any one else can change. Such advice is not only vain, but it works mischief. The farmer fails to accept the advice not because he is unwilling, but because he cannot. It is suggestive that every person thinks he can advise the farmer in his occupation; it is significant that the farmer does not undertake to advise other occupations and professions.

It is simple enough to change an outside or commercial condition in relation to the farming occupation; it is quite another matter to expect the farmer to accept it unless other essential conditions are changed to meet it. Fixing the price of any product, while it may be necessary in times of crises, does not add fertility to the land, or modify the weather, or affect the habits of a sheep or a horse or the requirements of a herd of swine. To say that a billion dollars is to be added to the income of farmers by war prices means nothing, unless we have at the same time a statement of outgo. To say that the increased gross value of farm products of 1917 over 1914 represents war profits is to state only one factor in a transaction, and to state it loosely. To advise the use of less milk in order to save it does not take the cow into consideration; the cow is not a machine that can be stopped by turning off the steam and discharging the operator.

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To establish any regulation touching production on a basis of compromise or agreement between contending parties does not take into consideration the fundamental problems on which the regulation must rest for its operation. This is well expressed in Warren's recent statement following a long hearing on the cost of milk, that there is no known way of making a cow produce milk by argument.

The political method, which is the method of compromise or expediency, cannot change a single fundamental fact in agriculture.

### Is the Farmer Profiteering?

You understand that I am not defending the farmer—his acts are as much open to review as those of any other citizen—I am merely stating his natural situation. As illustration, let me refer to the recent charge that he is profiteering. The farmer does not make profit in the commercial sense, but only a labor income. Now and then a farmer may buy and sell without producing, or even speculate, but this is not farming. The producing farmer does not become "rich" in the commercial sense. His occupation yields only the returns from his work. His overplus is likely to go back into the land, and the next generation has the benefit.

One of the most amusing statements I have heard is that reported of an influential financier to the effect that we must now take the farmer in hand and control him. The idea is that the farmer is becoming too powerful and makes too many demands. Now, for the past ten years or more public men have been advising the farmers to organize for protection, and the farming people have been shown the results that have been won by organized labor and industry; yet as soon as the farmer begins to use this dangerous weapon, a shout of alarm goes up from those who have advised it. If the farmer anywhere uses the weapon of organization, he only follows the precedent of industry and commerce. This is to say that the weapons of industry and commerce are then turned against themselves. The present mood to discipline the farmer is but another expression of the old disposition—so old as to be automatic—that the farmer must be kept where he belongs.

### Agriculture Very Little Organized

In fact, however, agriculture is yet very little organized commercially or politically. Former attempts have failed. We are watching the two movements now before us with new interest; it is yet too early to measure their accomplishments. It is now charged that farmers are withholding the sowing of wheat in order to hold up the prices. In the first place, there is no organization of farmers that can control the wheat situation; and if any number of individuals reduced their own production they would be playing into the hands of the heavier producers or of handlers. It is impossible for farmers to control their production as manufacturers control their output. Whether a man sows more or fewer acres of wheat, he does not know what his crop will be: the unpredictable conditions that make the wheat crop are too many.

Organization for commercial offense, or even for defense, is indeed a dangerous weapon. It is dangerous in itself; it is dangerous because it forces government into compromises, and also because it relieves government of its plain obligations; it is dangerous because it sets one part of society against another. In agriculture it is specially dangerous: it has here all the danger that it has in any other realm, and, besides, it cannot change a single natural condition.

[Having laid down these general statements, the speaker illustrated by calling attention to advice that is likely to be given the farmer and which cannot be applied because it does not fit. He spoke about plans for doubling the produce of the poultry yards and other stock, bringing out the fact that this requires more feed, and that this feed cannot be fed to livestock and to humans and certain parts of it sent to the Allies at the same time. To talk about doubling the output easily in poultry or some other special line under the limitation and conditions that are now apparent may be little more than nonsense. He also spoke of the fallacy of trying to secure more beef by allowing the veals to grow up. Veal is practically a product of the dairy regions, and the only reason for desiring calves is that the cows may freshen. If these calves are all kept for beef, then they will compete with the cows for feed and labor and the dairy business will greatly suffer. Recent studies have shown that possibly one way to increase the supply of meat is to kill the veals earlier rather than later, so far as it can be done within the law.—Editor.]

### Food and the Labor Problem

The food problem is now on us with staggering force. Fighting men, munitions and similar supplies, and food, are the fundamental or essential materials in the prosecution of the war. We now face the problem of supporting vast armies in a foreign land, making good the losses by land and by sea, and supplying the needs of millions of allied and neutral peoples. We are to expect that the problem will increase in magnitude. Never has a people been presented with a food problem of such stupendous proportions.

At the outset we are to face the contingency of the probability of a lessened yield. In the three war years the yields of the staple grains have been heavy. Only five times previously in the last twenty years have they been as great. This fluctuation is due, to a great extent, to unpredictable conditions of weather and climate. In two of the years the yields have been very low, and if very untoward conditions should arise next year, it is well within the range of possibilities that disastrously low yields might result, although they are not expected. We must take every precaution, therefore, to reduce all the elements of chance that are reducible in order to safeguard the situation and to secure a food supply as nearly adequate to the situation as possible. We are already applying these cautions effectively.

The labor condition may prove to be the key to the problem. Farm laborers and farm operators both are involved. They have volunteered; they have been drawn off by the great industrial demands, receiving wages that food production cannot pay; they have been drafted. The situation is not to be met by argument or by any array of tabulated figures. The actual experience of the farming people the country over must be accepted as true. The farmers also must coöperate to the full.

Farmers should not be exempted as farmers, for exemption is not a class interest. Yet we must save the energies of the people for the production of food as well as for other war purposes. Some of the harvest of food may be accomplished by volunteers, young and old, sent to the rural districts when emergencies arise; this, however, affords no solution of the regular and steady application that is needed on the land, a need that is now greatly increased. The producing of food, as the producing of anything else, needs dependable and experienced labor; food production needs farm labor rather than city labor.

### FOUR REQUISITE FOOD REGULATIONS

The food production is not to be maintained by the ordinary processes of economic regulation, particularly when the law of supply and demand is so much interfered with or even abrogated. Many movements and activities will influence the production, but four are of paramount importance.

1 We must save the food. This saving is not only economizing in the use of it, whereby we reduce the waste, but quite as much in the redirection of the diet and the reconsideration of the family activities. Fundamental changes are to take place herein if the war continues any length of time. To every person in the land, to every family, to every hotel and club, to every social organization, the call must come to consider whether the present eating habits are either sound in themselves or patriotic. Not only does the question of wheatless and beefless days seem to be involved, but that of better dieteties as well.

2 We must save labor. Extensive activities employing labor; perhaps whole industries must be stayed; perhaps some of them should never be revived. If we eliminate the useless and also the unessential, we shall be able to release much labor. The simplifying of the household scheme will also liberate woman labor for industries and farms; we shall need it all. If the war long continues women must take the places of men in countless industries where heretofore only men have been employed.

3 We must grow more food on the small home properties in city and town and suburb. This is not farming, for the householder does not maintain himself and family by the raising of supplies. This activity is justifiable only so far as the operator does not demand labor that can be used elsewhere. Himself and members of his family and household establishment should do the work. There may be many failures and disappointments; but there is no charge for labor. What energy one puts into the raising of food is likely to be deflected from less patriotic uses. Much foolishness is displayed in some of these home food gardens and in some of the semi-public enterprises of this kind. I hope that something has been learned this year. We may expect better results next year, even if the gardens should be fewer. We shall learn to grow the dependable things, few in number, and those that can be utilized to best advantage in the family. Great secondary and civic gains will result from this tilling of the land by the sweat of the face. Yet, with all that can be accomplished in the making of home gardens, we shall not affect the production of the great staples, as the breadstuffs and the red meats; but we may relieve ourselves of the necessity of using so heavily of these staples, thereby saving them for export.

4 We must directly increase production on farms. To this end we must establish food production on a wartime basis, giving it the best economic protection and the directest aids. Here lies the great remedy. The major strategy of the nation having been determined, we must then apportion and distribute the activities of the people toward the accomplishment of the one result. No industries or activities should be allowed to proceed at the expense of munition making and food production, or with the distribution of them, or any part to work to the disadvantage of another part: all the parts make the whole. The entire people now makes war. The war is one problem. If by stimulation, oversight and regulation the food situation cannot be met, then men must be assigned to farms as definitely as they are assigned to armies.

North America is the last defense in the food support of the war.

## THE FUEL PROBLEM

BY PROF. L. P. BRECKENRIDGE, NEW HAVEN, CONN.

PRECISELY stated, the fuel problem is that the coal bin of the United States is not full. How much do we need to fill it? One hundred million tons. Can we get it? We will try to produce more coal. We may produce fifty million more than we have ever produced, but we shall have to save another fifty million.

If you will build a coal bin 1000 feet on each side, that coal bin will have to be 4½ miles high to hold the coal which must be mined this year in the United States. That is a good-sized coal bin, higher than any mountain in the United States, and it takes a good deal to fill it, but if everybody saves a little coal we will save fifty million tons.

The question of the fuel problem is divided into three parts: the production of coal, the distribution of coal, and the use of coal.

In connection with the subject of production, Dr. Noyes, of the Fuel Administration Department, says that there is no use of producing coal—taking it out of the mines and piling it around the mouth of the mine. It is better to go down into the mine and get it with the machinery available than to raise it when there are no cars to put it in. If that is so, and it seems entirely probable, the coal in the mine is ready to be taken out and is being taken out as fast as cars are put there to receive it.

The railroads of this country distribute a large proportion of our coal, about 85 per cent, and nearly 35 per cent of the entire freight they haul is coal. No wonder we would like to fill the coal bin just to have the coal, but we would like also to get rid of the job of hauling it. We need the railroads for other things, not only for hauling food, but for materials which go into munitions. The problem of distribution is after all one of the most serious problems in connection with the fuel problem at this moment.

The problem of the use of coal divides itself very naturally into two parts: First, if we are to use coal we should use it with economy; second, will the time come when it will be necessary to limit the supply of coal to certain industries? If we are careful of the coal we possess that will not be necessary; but if we are not, there will have to be some priority of use of coal.

It is preëminently the function of the engineer to use coal with economy. During the entire period of this Society's existence, 38 years, I doubt if there has been a meeting when papers were not presented which referred to the economical burning of coal, or the economical use of steam, or the economical use of electricity. They are one and the same thing, as we burn coal to make steam, to make power, or, as a secondary product, the electrical energy which is to be distributed for power and lighting uses.

Sixty-seven per cent of all the coal produced is used to make steam. The steam is not all for power purposes, however, part of it going for heating. But this use of 67 per cent of the coal production shows the desirableness of using economy, and saving a lot of this coal by saving steam, and by saving the power we make from steam.

The United States, Great Britain and Germany produce the coal of the world, the world's production now reaching about 1,600,000,000 tons.

In the United States we mine, speaking broadly, two kinds of coal, anthracite and bituminous. All of our anthracite coal comes from Pennsylvania, from Scranton, Wilkes-Barre and vicinity, and we have never yet produced 100,000,000 tons a

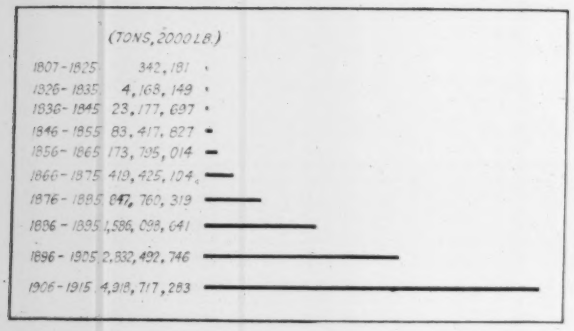



FIG. 1 TOTAL ANTHRACITE AND BITUMINOUS COAL PRODUCTION IN THE U. S.

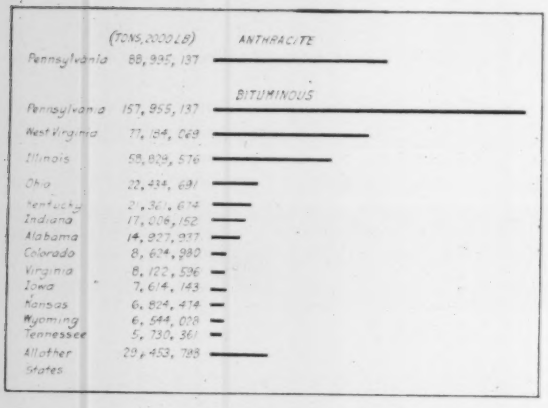



FIG. 2 COAL-PRODUCING STATES, 1915

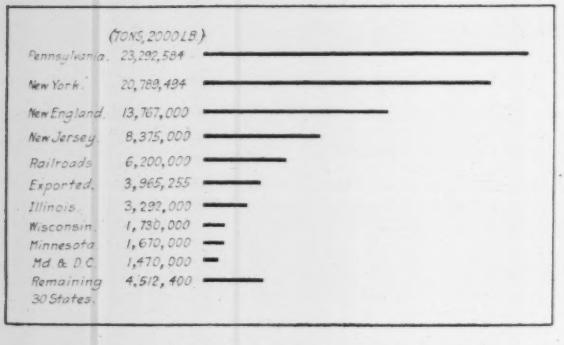



FIG. 3 STATES USING ANTHRACITE COAL, 1915

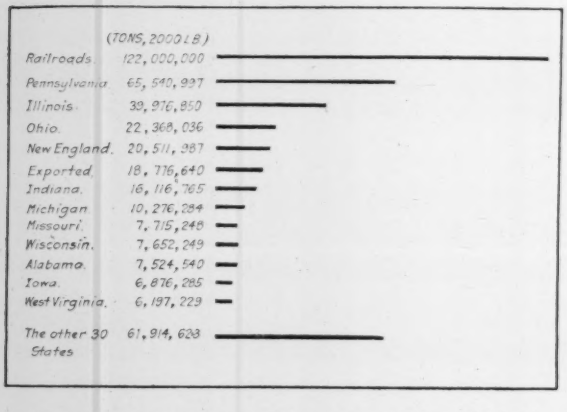



FIG. 4 STATES USING BITUMINOUS COAL, 1915

year. In the rest of the country we get bituminous coal, which varies much in its composition. We get most of it from Pennsylvania and West Virginia, a lot from Illinois, and a little from the lignite fields west of the Mississippi. We are producing bituminous coal in increasing amounts, and will mine close to 600,000,000 tons this year.

Anthracite coal becomes more valuable in the ground next year, and we have only enough to last perhaps one hundred

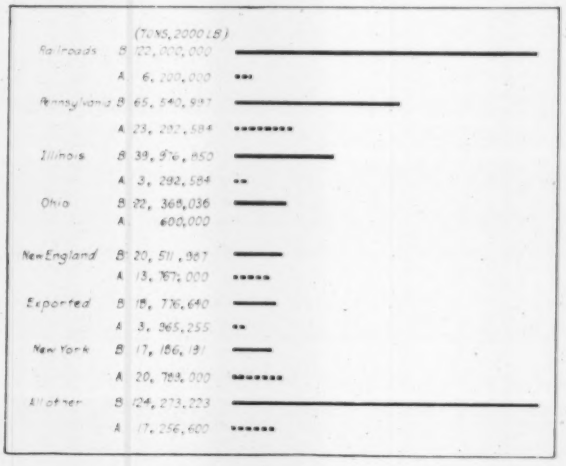



FIG. 5 BITUMINOUS AND ANTHRACITE CONSUMPTION, 1915

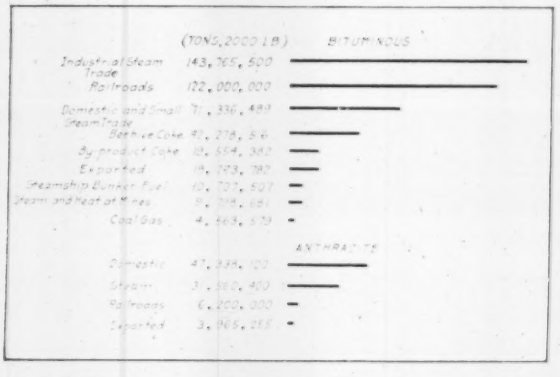



FIG. 6 COAL CONSUMPTION IN U. S. BY INDUSTRIES, 1915

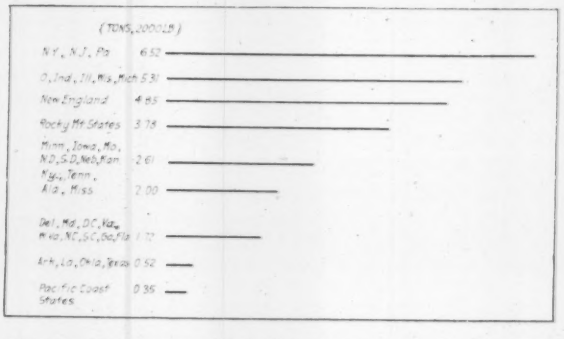

(TONS, 2000 LB)
N.Y., N.J., Pa 6.52
O., Ind., Ill., Mo., Mich 5.31
New England 4.85
Rocky Mt. States 3.78
Minn., Iowa, Mo., N.D., S.D., Neb., Kan 2.61
Ky., Tenn., Ala., Miss 2.00
Del., Md., D.C., Va., W.Va., N.C., S.C., Ga., Fla 1.70
Ark., La., Okla., Texas 0.92
Pacific Coast States 0.86

FIG. 7 PER CAPITA COAL CONSUMPTION IN U. S., 1915

years. Our bituminous coal will last us 1500 years, according to Geological Survey estimates. A few slides are now in order.

Fig. 1 shows the coal production at each ten-year interval in the United States, beginning in 1800. Up to 1885, about the time this Society was formed, we had not mined in this country as much as was our increased production in the last ten years.

Fig. 2 shows the states which produce coal, Fig. 3 those which use anthracite, and Fig. 4 those using bituminous. This year I think the railroads alone are using 145,000,000 tons, and will need, and must have, perhaps, more.

Fig. 5 shows the proportion of bituminous and anthracite coal used by the various states. The railroads only use a very little anthracite compared with bituminous. Illinois uses only a small amount of anthracite. Ohio uses a very small amount of anthracite, less than the city of New Haven. New England uses more bituminous than anthracite.

Fig. 6 shows the coal consumption by industries. Fig. 7 shows the per capita consumption in various sections of the country. In the Pacific Coast states the consumption is only about one-third of a ton per capita—they use hydroelectric power and burn oil in their steam power plants, and as the winters are mild they do not use much for the purpose of keeping warm.

The fuel administration has a coal-conservation department, in charge of Dr. Noyes, and his activities reach to every state where there is a fuel administrator. The Bureau of Mines, augmented by a committee appointed by the four national engineering societies, is acting as technical adviser to this conservation department. The various engineering societies can give much help to this question of conservation in their own localities, and it would seem they should coöperate with the fuel administrator in their particular locality.

The United States Chamber of Commerce, having connections with 950 cities in America, is issuing from time to time valuable information bearing on this subject, and its committee on coal conservation has invited Dr. Hollis to appoint a number of engineers to sit with them; and so they are helping in that way. In many of the state fuel administration offices we have engineers working with them to help save coal.

## MOTOR-TRUCK TRANSPORTATION

By WILLIAM P. KENNEDY,[1] NEW YORK, N. Y.

MOTOR-TRUCK transportation has now become firmly established in military and commercial service, and the purpose of this paper is to point out the developments to be expected from our immediate necessities created by the existing condition of war.

There are three stages to the introduction and development of most of our industrial utilities; first, the pioneer stage in which the designer and producer bring the apparatus in question to a condition where it can be practically employed as an economic device; in this stage there is a period during which considerable missionary work must be done to induce the prospective user to recognize its economic advantages. The next or second stage is that in which the apparatus is used in a preliminary way, during which period the user becomes gradually familiar with the possible accomplishments of the device and begins to have confidence in its commercial value, by being able to satisfy himself definitely of the reduced expense or increased performance which he is actually gaining by its employment. The third and last stage is that in which the device becomes a competitive necessity in the hands of the user, due to its general employment in commercial service. In rare instances the coming of this stage may be hastened by some extraordinary situation in which the failure of existing means for performing equivalent service forces the employment of the new device as a necessary substitute.

In the development of the use of motor-truck transportation we have now reached the beginning of the third stage, just described, and are confronted with a situation where the older means of transportation is so overcrowded and congested as to demand the immediate and general use of the motor truck as an urgent expedient for relief. Our general situation therefore at the present time of congested rail and water transportation may be the greatest possible boom that could exist for a very extensive development of highway transportation, by means of the motor truck. This development during the next year or two will probably be the equivalent of that which would gradually take place over a period of twenty-five years under normal circumstances.

As indicated above, the reliability and economic value of the motor truck is already established. The employment of these machines to the number of 300,000 throughout the country in commercial service is sufficient proof of this. In its application to military requirements there has been a more rapid and conspicuously successful development, as is evident by their numbers and the character of their service in the various zones of military activity in Europe, as well as the great quantity employed for military requirements at the home base of each of the belligerent nations.

While the motor truck cannot be regarded as having created any revolutionary change in methods of warfare, the effective character of its service, wherever time has been an important element, has had a marked influence in speeding up military operations. It has consequently found its place as an indispensable adjunct in military equipment, from which it can never be displaced and in which its usefulness will continue to extend. The motor truck has provided the army with other utilities beyond road transportation of munitions and supplies, in furnishing the speedy ambulance, the scouting armored car, the mobile gun, the powerful caterpillar tractor, and finally the tank as a formidable fighting machine.

There may be lines of demarcation as to the limitations of the motor truck in military field service between the railroad in the rear and the army mule at the front, but its permanency and usefulness in between these limits is unquestioned. The extension of its application in overlapping the service of the railroad and supercceding the army mule has been demonstrated in many occasions of emergency, and it is therefore likely to continue forcing its value in both directions as its superiority becomes more frequently demonstrated in cases of actual necessity.

The motor truck is already so well entrenched in military service that our Government has been abundantly supplying itself with many thousands of these machines. It has been able to take advantage of the experience of other nations engaged for a longer period in the conflict to furnish itself with the most suitable equipment which the industry could provide as its regular commercial products. It has gone a step further in securing through the collective coöperation of the engineering ability of the industry several special types of motor trucks, the design of which is based upon the accumulated experience of three years of vigorous warfare; while the industry in the few years of its rapid growth has become so substantial that the emergency requirements of 30,000 to 50,000 motor trucks can be furnished almost as a matter of course, and without any serious impediment of the routine conduct of its business.

Our immediate interest is now concentrated not upon these past accomplishments, but in a determination of what are to be the demands of the near future in furnishing domestic highway transportation to aid in conveying, from our scattered centers of production to our seaport terminals, the vast quantities of supplies and munitions required to maintain from

[1] Consulting Engineer.

one million to five million men in the field in a foreign country.

We have already in evidence the limitations of our old-line means of rail and water transportation, and although vigorous steps are being taken to find satisfactory remedies for their congested condition, the problem of making these already overworked facilities conform to our increasing necessities is an extremely difficult and complicated one. The situation calls for extraordinary activity and extraordinary methods in finding its solution, and one of the principal factors which will develop as an element in the solution of this great problem will be the employment of motor-truck trains in scheduled operation over our principal highways.

The producer, merchant and consumer of materials requiring transportation from one place to another throughout the country have become so habitually shackled to the limitations of our railway and waterway transportation facilities that it is extremely difficult for the prosaic commercial mind to release itself from its accustomed methods and to rise up and find a new and efficient means of relief. It will probably require the superior genius of the military mind in its capacity for meeting emergencies, coupled with the resources which military organization provides, to take preliminary and effective steps toward making use of the motor truck and the highway to offset the limitations imposed by our older transportation systems.

Fortunately, the situation has all the elements which can possibly contribute to success practically lying at hand waiting to be utilized; and the only thing remaining to accomplish the purpose required is the necessary authority with a competent executive or administrative organization to put into actual operation road motor trains adjacent to all the centers where freight congestion now exists.

The ability of the motor truck as an individual operating unit or as a tractor coupled to trailer equipment has been well demonstrated under a great variety of operating difficulties throughout the country. All the highways in the country may not be fit for transportation of this kind, but over the comparatively limited number of routes where the operation of such motor trains would be required the conditioning of highways is either an accomplished fact at present or could be made so with little difficulty or loss of time, by making use of the facilities which most of the state highway organizations have at their command and are ready to supply for such emergency requirements almost immediately upon notice to do so.

In the present-day motor truck, backed by the brains and facilities of one of the greatest industries ever developed, we have the means for providing transportation equipment with which we can accomplish extraordinary service. For several years past the manufacturers of motor trucks, under the stress of keen business competition among themselves, have developed the machines produced to a point where they are capable of performing almost any task allotted to them. Aside from their normal functions of transporting freight, they are in many instances called upon to perform a great variety of military service incidental to transportation. In some cases their equipments constitute portable power plants for performing service of some distinct character, such as that required in lodging and mining camps. They occasionally furnish lighting. Frequently they perform loading and unloading operations, such as the hoisting and dumping of coal bodies, or the removal and replacement of separate bodies which have been loaded while the truck itself has been absent on its delivery route. In fire-fighting service they are practically replacing the old line of equipment, and a special type of motor truck has been developed which is now regularly known as a road builder, hundreds of which are doing marvelous work in the rapid development of our highways.

It will therefore be seen that under the intensive development of competitive motor-truck equipment the manufacturers have been prepared for just such emergency requirements as they are now likely to be called upon to meet, and therefore any organization which may be developed, either by the Government or by commercial institutions, to solve this problem of highway transportation will find the truck manufacturers perfectly competent to furnish quickly suitable machines in any capacity or number that may be required.

With this assurance as to an adequate supply of rolling stock, the next step in the project will be to put a few selected stretches of highway into serviceable condition and to keep them so.

Whenever the question of highway transportation has been considered in the past, the good-roads topic has always been introduced and discussed in terms which embrace the entire road system of the country and the magnitude of the task of putting this complete system into first-class shape is usually dwelt upon as an almost insuperable accomplishment. It requires, however, no very great analysis to bring out the fact that only a very small fraction of one per cent of the highways of the country would be required for the contemplated service of relieving our present congestion or expediting the movement of freight between the principal centers of production and our seaports. This being so, the facilities now available in each state for the construction and maintenance of its roadways, if concentrated intensively upon the few routes likely to be required for this character of service, could put them in excellent condition and keep them so with comparatively little effort and expense. Consequently, this project of bringing into existence organized highway transportation has none of the cumbersome impediments usually attendant upon railroad extension.

Many cases already exist where limited highway transportation is operated on schedule over definite routes. Many more systems would come into existence rapidly by virtue of their commercial value were it not for the fact that it is difficult to procure capital in large quantity for this kind of investment. One of the alleged reasons for this difficulty is the fact that the power of railroads has in the past been used to obstruct parallel competition of any kind, and this promotes the belief that if road-transportation operations were organized on a large scale the same influence would be felt in interfering with their development and prosperity. If this is really the case, then it will require initial steps on the part of the Government in such an emergency as the present one to put into extensive operation road-motor-transport service, and incidently prove its practicability and establish the permanency of such methods. Action of this kind should be advocated and strongly urged for the many advantages which would result from the spread of the use of this highway motor transportation. Its competitive influence would be a very valuable one to the public, as placing in the hands of producers and merchants their own independent facilities for limited freight movement would bring about marked economic changes in which all would be likely to benefit.

We should not be slow to take advantage of the lessons which have been taught us in this direction by France, England and Italy, in carrying into effect, almost immediately upon the opening of hostilities, road motor transportation upon an extended scale. Some cities and many of the small towns in these countries are almost entirely dependent upon

the motor truck as a means of conveyance, and the well-defined organization which has been brought into existence to maintain the equipments employed and to keep in condition the road surface required, are examples that should exercise a stimulating influence upon us to make advanced preparation towards meeting the more serious conditions which the increasing demand for transportation is likely to force upon us.

### DISCUSSION

George P. Hempstreet, in discussing Mr. Kennedy's paper, said that he wished to call attention for a moment to a peculiar state of affairs. We had one branch of the Government anxious to promote motor transportation, and had been assured that there was an ample supply of rolling stock available. In order to use that rolling stock it was necessary to have a highway to run it upon, the first requisite of which

45-HP. HOLT ARTILLERY TRACTOR WITH ARMOR DOORS OPEN

was a sufficient foundation, generally of crushed stone or gravel.

Another department of the Government had issued Priority Order No. 2, which prohibited the shipment of gravel or crushed stone or anything to be used for road construction in open-top cars. Most of the quarries from which crushed stone was taken could only put their materials into open-top cars, as it was very difficult and expensive to use any other type of car, and very difficult to unload it.

The question might be asked, Why not use motor trucks? A motor truck could be used to haul a load of five tons, and if the load was worth $1,000 the $25 charge for hauling would not be very excessive. But if the load was only worth $2.50, a freight bill of $25 would be excessive and prohibitive.

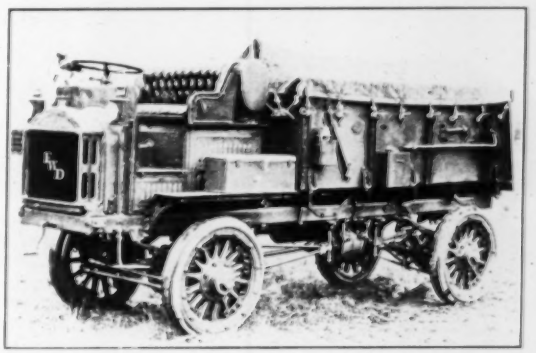
So we had one department of the Government which wished to have motor transportation and to use good roads, and another which was preventing their construction.

There had been every effort made to relieve freight congestion in the East by the use of motors to haul high-grade goods rather than use freight cars, but a branch of the Government was practically prohibiting the building of roads on which such motor trucks could be used.

## ARMY TRANSPORTATION

BY MAJOR L. B. MOODY,[1] WASHINGTON, D. C.

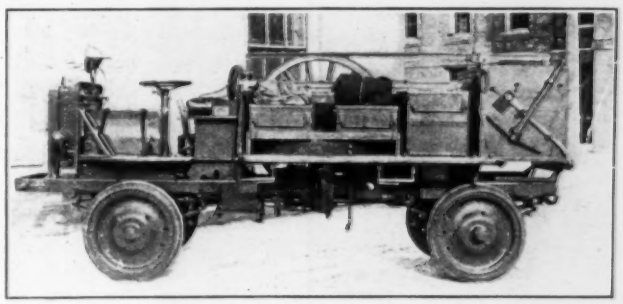
THIS question of army transportation is a pretty broad one, and in general it comprises very broad and distinct classes of service, all back of the fighting lines. When you go into the zone where troops are operating the first assumption is that there is no road, and also that transportation



ALL-STEEL AMMUNITION MOTOR TRUCK DRIVING ON ALL FOUR WHEELS

becomes specialized, that is, the Medical Corps do not want their patients handled on the cubic-foot or pound-per-mile basis. Likewise, the engineers have special apparatus, such as portable searchlights and demolition equipment. The Signal Corps has its wireless outfit and equipment for their aeroplane service, etc. The Ordnance Department depends on the motor transportation, as it furnishes all the field guns and the materials known as munitions.

When the question of replacing the horse in this special service came up, it was referred to the Ordnance Department. There is no serious difficulty in replacing a horse where you have a road; but where you have no road and where you have got to be 100 per cent certain that you will arrive at your destination, that is where the difficulty of replacing the horse with the fighting troops has come in. That is, if the general supply trains fail on the main roads, it is possible that the men might go hungry for a day. But, if on the other hand



JEFFERY SUPPLY TRUCK FOR 4.7-IN. GUN BATTERY

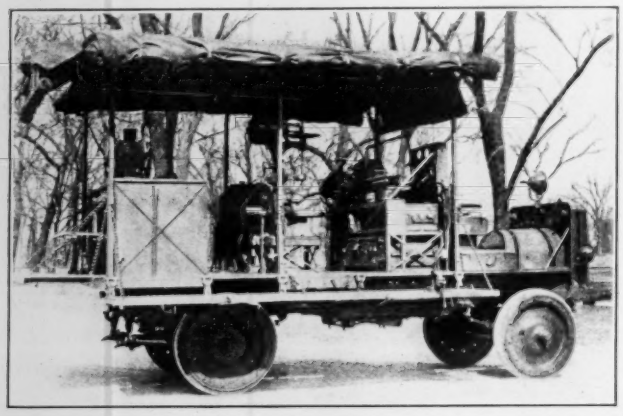
you wish to use a gun for a certain purpose, it is of no use to have it arrive a day late—it must be there on time. That has led to special forms of transportation.

As to the volume and the organization, it can be said that practically every gun handled by the United States Army will

[1] Carriage Division, Ordnance Department, U. S. A.

be handled by motor equipment; and if we get an army approximating in size those on the other side you will obtain some idea from the number of guns engaged of the magnitude to which this important matter of transportation has now grown.

I do not want to say our problems are solved, as they are not, but from operating the experimental equipment we had at the middle of April last, we have progressed from one officer in charge, a couple of officers, and a couple of draftsmen and five desks, to the point where we have schools turning out men to repair these trucks at the rate of 30 to 50 trained officers and several hundred trained men every month. We have estimated the number of men actually building these trucks (not counting those in related industries) and they number about 50,000. The number of officers actually on duty is from 300 to 400, the number of enlisted men runs into the thousands, all for repairs only.



JEFFERY REPAIR TRUCK FOR 4.7-IN. GUN. DROP SIDES IN WORKING CONDITION

The cost of this will exceed that of the Panama Canal, and the Ordnance Department has expanded something like forty times, by actual count, in the last eight months of its history.

We are endeavoring in the department to handle this problem ourselves, but we would have made but little progress but for the assistance received, particularly in my section of the Ordnance Department, primarily from the Society of Automobile Engineers, and from those among our officers who belong to The American Society of Mechanical Engineers or who would be eligible for membership. Without the assistance of these trained men it is safe to say that we would be nowhere.

[Major Moody then briefly described a number of views which he had projected on the screen, these views showing various forms of specialized motor transport, including ammunition trucks, a repair truck equipped with machine tools, an armored car, a tank, late forms of standard tractors used for hauling guns, a few of which are herewith reproduced. Four of the views were of unusually bad road conditions that could be successfully met by tractors, but in no case by horses. The facts that horses can be reached with poison gas and cannot be camouflaged as can the tractor, along with particulars regarding difficulties in ocean transportation, were given by the speaker as some of the reasons for the adoption of tractors.]

# THE AIRCRAFT PROBLEM

BY DR. W. F. DURAND, WASHINGTON, D. C.

IT IS perhaps fair to say that when hostilities were declared last April, no one at that time in connection with the Government had any vision of the part which the Air Service was destined to play in the plans which were soon to be developed. It is perhaps further fair to say that it was not until the visits to this country of the Balfour and Viviani-Joffre missions that these ideas began to crystallize into definite form. Very promptly, however, they did commence to so crystallize, and we began to get some vision of what the air service might possibly mean. Immediately there arose a series of the most important problems which have ever been presented to the United States and to her engineers in an engineering and industrial way.

I have jotted down a few of these problems, as follows:

1 Of the various types of machines, fighting, reconnaissance, bombing and training, what number shall be set as a goal for active service at one time?

2 What wastage in such machines is to be anticipated?

3 In consequence, what numbers in each type must we be prepared to build within a twelvemonth or any other specified time?

1 How many trained aviators will be required to maintain the desired number of machines in active service?

5 How many men must be put through preliminary training in order to secure the needful number of active aviators with the necessary reserves? Or, in other words, how much raw material must be handled in order to secure the necessary amount of finished product?

6 How many mechanics and repairmen will be needed to keep this fleet of airplanes in all classes up to "concert pitch," and ready for instant service at any time and at all times?

7 Where and how are we to undertake to build the number of airplanes indicated as necessary as the gross output, say for a year, in order to maintain the fleet continuously at proper strength? Or, put otherwise, we may perhaps well ask what is the maximum number of airplanes which can be built in those various classes in the United States, or by the United States, without undue disarrangement of either needful war industries and of the irreducible minimum of peace industries?

8 To what extent will further demands be placed on air productive capacity by demands of our allies in Europe for airplanes or engines in types which we may hope to produce with high economic efficiency? and to what extent may we expect to draw upon them for certain types—as, for example, the fighting scout—thus relieving the United States to some degree of attempting, at least at the start, to produce this final word in the evolution of fighting aircraft, as developed on the battlefields of Europe?

9 To what extent will the demands of our allies call for raw material, such in particular as airplane timber? Will the total demand exceed the presumable supply, and if so, to what substitutes may we turn?

In considering this question, certain conditions are obvious. There is no use of talking about an air service if the number is to be limited to hundreds. If we have any vision of the activity and efficiency of air service as now conceived, it must mean the production and operation of airplanes in large numbers, measured in units of thousands and not hundreds. We must therefore fix as a number, in order that it may have any significance in the problem, a number measured in thousands. If

we can say five thousand, it is well. If we can say more, it is better. There is no definite answer to this question; but we are committed to maintain airplanes, once we are under way, in many, many thousands.

Again, what wastage in such machines is to be expected? That is a matter of statistics, and the data for the accurate determination of the answer to this question are not available. The data are contradictory. We lack definite information as to the average life of machines. Under certain conditions one may continue in active service a month, a week, or perhaps a day. But machines do not fly every day; conditions of weather intervene, and of the 365 days of the year only a fraction of them will be available for the fighting machines on the front. So, taking the average, we get to the approximation that the effective life of the machine will be several weeks, possibly two or three or four months.

In consequence, what numbers in each type must we be prepared to build within a twelvemonth or any other specified time? This is tied up with the question, how many can we build? And the answer is the same. We must be prepared to build airplanes in thousands. We must be prepared to build a multiple of the number in active service at any one time. If we are to maintain 5000 airplanes in active service at one time we must be prepared to supply during the twelve months a multiple of three, or four, or five or six times that number.

### How Many Aviators and Mechanics Do We Need?

Again, how many trained aviators will be required to maintain the desired number of machines in active service? Obviously, there must be one for each machine in service. With modern machines, carrying more than one man, we must maintain in active service more than one man in each machine. There has been a tendency not always to insist upon the capacity to handle the machine on the part of every man who goes up. A man may be a good observer without being a good pilot. But this is not a good ideal. We believe that no man should go up in a machine for any purpose whatever without his being able to pilot the machine; to manage the machine in case the regular pilot is injured or killed, and to bring the machine back within our own lines. That means there must be a number of men trained for auxiliary service, but with a given minimum of skill. It is obvious the number of men we must be able to turn out in the course of a twelvemonth must be measured in units of several thousands. Five thousand would be minimum, and we must look toward some multiple of such number.

With regard to the actual provision for meeting this requirement, it is perhaps proper to give some idea of the capacity of the schools now occupied in this particular work.

The first step in training an aviator is to give a brief course of eight weeks in the so-called ground school. This is a school intended for preliminary instruction, not including work in the air. It includes elementary instruction in the principles of flight; in the principles and operation of internal-combustion engines, meteorology, photography, scouting, machine-gun work, reconnaissance work, and comprises lectures, class work and laboratory exercises in these subjects. This course runs for eight weeks.

The course contemplates the feeding in at these institutions of twenty-five candidates per week, and the feeding through and graduation each week of whatever is left of the twenty-five, taking into account the wastage. Without wastage it would mean twenty-five per week for each school to go to the flying schools; and with eight schools there would be about two hundred cadets a week, or something of the order of ten thousand per year.

There would be, necessarily, a considerable wastage and perhaps not more than one-half of that number can be expected to realize an efficiency which will make them significant units in the program as time goes on.

The capacity of these schools could be multiplied, and such multiplication is now in process of development. There need be no ground of apprehension about training these men, assuming that we can obtain properly qualified young men, with the necessary personal, physical and mental characteristics such as are needful to enter into the composition of the bird man.

It is true that of men qualified for the last and highest degree, men whose nerves and muscular reactions are such as to make them react instinctively—as bird men—the number is small. But, on the other hand, every well-built, normally developed and endowed young man is able to develop a degree of skill adequate to render him an effective unit in one place or another in the air service, even if only a few reach the supreme excellence which we see in some of the specially trained airplane fighters.

The number of these engineering, technical and scientific schools can furthermore be multiplied two, three or four times, and the capacity of each can be multiplied perhaps by two, on the average, and we thus have abundant possibilities for the development of a very large amount of material for ultimate service in connection with the plans now in formation.

The number of mechanics and repairmen is again a matter of experience, and it is found that for every airplane there must be one specially skilled mechanician who will give his entire time to the maintenance of that particular machine; and for each group of twelve, twenty-four or thirty-six, there must be an additional number, and in the base supply depots and other points back of the line there must be others.

If we go back to the supply of gasoline and lubricating oil, and to the supply of elements of that character, we may greatly multiply the number of men necessary to maintain in a state of efficiency any one airplane. But stopping short with the number of men concerned with the machine itself, we must multiply the number of aircraft by three, four or five.

If we take into account the number of fliers contemplated and the number of mechanics and repairmen behind the line in one capacity or another, it results that the contemplated officers and personnel of the Signal Corps will exceed the entire standing army at the outbreak of the war.

### How Will We Maintain Our Air Fleet?

The next question: Where and how are we to undertake to build the number of airplanes indicated as necessary as the gross output, say for a year, in order to maintain the fleet continuously at proper strength? Or, put otherwise, we may perhaps well ask what is the maximum number of airplanes which can be built in those various classes in the United States, or by the United States, without undue disarrangement of other needful war industries and of the irreducible minimum of peace industries?

Now this question No. 7 comes closest to us as engineers and men concerned with the industrial affairs of our country: Where and how are we to undertake to build the number of airplanes indicated as necessary as our gross output? Where

to find and how to develop the tremendous extension in the industry necessary to provide this enormous number of airplanes for immediate production? It means the development of an industry, highly trained and highly specialized—not, indeed, out of nothing, but out of very small beginnings. Perhaps I should say that it meant the crystallization of the elements of such an industry. And it was splendid that there were found shops, and trained personnel and equipment and organization for the production of airplanes, right in the automobile industry. It meant, nevertheless, an enormous extension in productive capacity beyond any vision which the wildest flight of imagination could have contemplated a few months ago.

Only a few weeks ago I was able to visit, by way of inspection, three of the principal centers of airplane production at the present time—Dayton, Ohio; Detroit, Michigan, and Buffalo, New York. There we saw new factories which were either completed and occupied or on the point of occupancy, aggregating something like thirty-five to forty acres of ground area, to say nothing of the gallery space.

Furthermore, there was ready for immediate expansion perhaps twenty-five to forty per cent in addition. It is fair to say that early in the next year there will be occupied actively in the production of airplanes something like fifty acres of ground area, with their gallery space, which did not exist eight months ago. And this is without taking into consideration the automobile factories. Acres upon acres of area in existing automobile factories are running solely on airplanes and airplane parts; and we are just on the edge of a period of very large production.

The period which has elapsed since last June or July, when the present program began to crystallize into reasonably approximate and definite form, has been necessarily spent in measures of preparation for this tremendous program of expansion and industrial development. And we may certainly anticipate within a few months, say two or three at the latest, that this factory capacity will be actively occupied in turning out airplanes at the rate of at least several thousand per month. The precise number I hesitate to define more closely at this time.

### What Further Demands Will Arise?

The remaining questions I will touch on more briefly. They are: To what extent will further demands be placed on air productive capacity by demands of our allies in Europe for airplanes or engines in types which we may hope to produce with high economic efficiency? and to what extent may we expect to draw upon them for certain types—as, for example, the fighting scout—thus relieving the United States, to some degree of attempting, at least at the start, to produce this final word in the evolution of fighting aircraft as developed on the battlefields of Europe?

The other one, the ninth, is: To what extent will the demands of our allies call for raw material, such, in particular, as airplane timber? Will the total demand exceed the presumable supply? and, if so, to what substitutes may we turn?

It is sure that the demands of the Allies will put to the test every bit of our productive capacity for airplane material. We are now making for them flying boats in large numbers, and they are looking more and more to us for the production of airplanes for the training of aviators. In fact, the nearest approach to the standardization of a definite type is the American type, for at least the American, Canadian and British services. And they are coming to look to us for other types as well, and for the production of airplane engines.

The demands for supplies are also at the limit of our productive capacity. The demand has been incessant for timber—spruce, spruce, and again spruce! Serious difficulties have been met with on the Pacific Coast in the way of supply, but on the whole the prospect seems to be improving.

Substitution of other woods has also been introduced in some measure, which, while they have different characteristics from spruce, yet give effective service. And then there are suggestions in the way of metal substitutes which seem to hold hopeful and interesting possibilities.

### The Problems of Standardization

One of the questions which presented itself again and again, and aside from the questions of policy or program, a question which is vital to the engineer, is that of standardization—standardization of elements and standardization of types. I need not take your time with a statement of the advantages of standardization of parts used in large numbers.

The standardization of elements, such as screw threads and fastenings, has progressed very satisfactorily; and for general airplane parts much excellent work has been accomplished through the efforts made by the Society of Automotive Engineers. And there is to be held soon in London an International Standardization Congress to which this Society has been asked to send a representative, and I understand that this Society will have one of its eminent past-officers at this conference as its representative and at which we may anticipate a still further approach toward standardization by way of elements and parts.

The other problem relates to the standardization of types, but here is danger. It is necessary to standardize; but it is fatal to attempt to standardize a type too rigidly, because if we know anything at all from experience on the western front it is that a type has no longer begun to prove a measurable degree of success than it is put out of date by the appearance of some new and improved type; and so as the weeks go by one type comes along after another.

The entire program must be based on the expectation of displacing from time to time types which for production purposes may be standardized for the time being, but which cannot be kept in production too long after the development of more efficient types.

I have tried to visualize this as a tremendous stream of production. Parallel with this stream of production we must have likewise a stream of development, research, investigation and a program which is seeking to contact with the unknown and the new; developing, judging, testing and determining their technical characteristics and their adaptation to the conditions of active service. And so fast as new types and forms are developed and proven superior, just so fast must they be fed into the stream of production, taking the place of out-of-date forms. Only in this way can we maintain the types and forms in use at the front responsive to the advance in the science and art of airplane production, and responsive to the conditions at the front and which must determine the characteristics of the material to be supplied at the fighting front.

### The So-Called Liberty Motor

I should not close my remarks without saying a word regarding the attempts to standardize the airplane motor. You are all familiar with the story of the design and development

of the so-called Liberty motor. I will not go into that at all. But you can appreciate the fact that of the various problems requiring standardization, that of the motor was one of the most important. The question was: Shall we copy outright a European motor? Shall we copy outright the best American motor? Shall we combine the best in American motors and make a new motor? or shall we combine the best in European motors? or shall we combine the best in European and American practice and call that the standard motor?

In effect, the latter was the program undertaken. Drawings of European airplane engines and to some extent actual engines were available in May and June when the characteristics of the Liberty motor were determined upon. The characteristics of the best in American practice were naturally present in the minds of the designers, and on the basis of this and the best information from Europe and this country, the determination of the characteristics of the Liberty engine was developed.

The first engines, as you will remember, were built in an astonishingly short period of time, a matter of twenty-eight days from the time two men sat down in a room at the Hotel Willard until a motor was set up, and two days later was ready for test at Washington.

Then there was the question of the anticipated "teething troubles." The motor has been taken to Pike's Peak and sent up the grade and tested at various altitudes; and while there have been varying reports in the public press in regard to this motor, I wish to say that the reports in some degree unfavorable which have emanated from certain sources have not been well founded. The motor has met and is meeting the full expectation of its designers. It has had, as every design is expected to have, minor difficulties and troubles, but not one of them has been fundamental to the motor itself, and they all readily admit of correction and removal; and means have been found for the improvement and correction of such troubles and the motor is now in course of active production and on a large scale.

A few days ago we saw in Detroit in one of the factories there the process of manufacturing the forgings of the Liberty motor cylinders. All of the forgings are being made in one plant, and that plant is to supply the trade with Liberty motor cylinders. The forgings are made by a hot-forging process from seamless tubing, and they were being put through at the rate of 1200 cylinders per day. The factory was planning to double that capacity and they are ready to go still further and increase capacity as the needs require.

Perhaps in conclusion I should mention two or three problems not solved yet and which are of special importance, and which I shall take the liberty of calling to your attention and recommending to your special thought and study.

One is the supercharging airplane engine; the engine which shall be supplied with means to secure the maintenance of the power at high altitudes, and not suffer the loss normally attendant upon working in a rarified atmosphere. If we have the same engine working at sea level and then soaring upward, it is found that the power diminishes with the density of the high-altitude atmosphere. Many devices have been suggested, but the problem is to realize the end in the most effective way and with the least cost in excess weight and added complexity. If we can solve this problem we can assure our supremacy in high-altitude service.

Another development is that of modifying at will or automatically the pitch of the airplane propeller. It is of small use to maintain power if the propeller is to maintain its same pitch in an atmosphere of reduced density. The engine will speed beyond the limit or the rotation speed of the engine will impose a limit upon the power which could be developed.

Some way or means is required, therefore, for properly modifying the pitch of the propeller in order that we may without undue sacrifice of efficiency cause the rotative resistance of the propeller in a rarified atmosphere to correspond in some degree to the continuing torque of the engine.

Another problem is that of the spark plug. The modern spark plug has been a development in response to automobile conditions, in response to the compression pressures which prevail in automobile practice. It is found that under the higher pressures in aeronautic service the spark plug, based on the automobile program, rapidly breaks down. The insulating characteristics are lost in one hour or two hours or ten hours, and there is a bewildering uncertainty as to the life of the spark plug under present conditions. This is one of the outstanding problems, particularly with reference to the increasing demands of modern airplane service.

One final thought is this: Throughout this trip of inspection we were very strongly impressed with the serious purposes with which the captains of industry in this field of production are approaching this problem. They realize its magnitude and its importance, and they are approaching it with high purpose and patriotism; and with the presence of such a pervading spirit in the industries of this country we are going to make good with regard to our pr[illegible]rplane production. Not quite what was hoped, perha[illegible] but we are going to make g[illegible] manufacture will not be our feast co[illegible] this world war, and toward settling it in the way we an[illegible] it will be settled.

## THE SOLUTION OF THE CANTONMENT CONSTRUCTION PROBLEM

By LEONARD METCALF,[1] BOSTON, MASS.

I HAVE been asked to tell you the story of the work of the Cantonment Construction Division, an organization which did not exist six months ago, which has built in this incredibly short period of time sixteen National Army Cantonments, with 26,500 buildings to house and care for 675,000 men; two embarkation camps for 43,000 men; one quartermasters' training camp for 18,000; additions to the regular army barracks, for 100,000; repair shop units; and the semi-permanent structures at sixteen National Guard camps, to care for 462,000 men; and which has designed and purchased equipment for certain large plants for our army in France, a tremendous task involving 200,000 men, and an estimated cost of approximately $187,000,000, over three-fourths of which has already been spent. It is a wonderful story, not of planning and preparation, but of doing seemingly insuperable tasks daily, an inspiring story of loyal and effective coöperation between army officials and civilians, the one with army traditions and experience, the other with their widely different professional and commercial training.

The cantonment work is done, a splendid achievement, creditable alike to the Government, to this bureau of the army, to the construction quartermasters at the camps, to the supervising engineers and contractors, to the railroads and supply men and to all concerned.

Not a sandpapered or polished job, but rough-hewn, strong and calculated to serve. Wasteful in certain details, no

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doubt, but economical in the best sense, for the saving in time here has saved life and treasure on the long firing line across the water.

Where can you duplicate the experience, involving as it does an expediture of $150,000,000, in six months' time, three times the maximum rate of expenditure in twelve months on the Panama Canal, and which increased tenfold the normal building activities of the country, without substantial increase in the cost of materials, from beginning to end of the task, due largely to the work of the War Munitions Board of the Council of National Defense and its committees; involving meager compensation to the administrators, designers and supervisors and voluntary service on the part of many skilled advisers, who dropped important personal obligations to go to Washington for days, weeks or months in response to telegrams asking for help; voluntary coöperation and work by the railroads, telephone, electric and other utilities, and substantial expenditure without guaranty of return; contractors taking contracts to build structures estimated to cost from $3,000,000 to $4,000,000 and actually building these and many additional structures so that the final contract sums ranged from $8,000,000 to $10,000,000 per cantonment, nearly doubling the necessary construction period, but without increase in compensation, and this when the compensation upon the building of the National Army cantonments was limited, *not* to a *profit of 10 per cent*, as has so often been stated, but to a gross return of *$250,000*, averaging for the sixteen cantonments less than 3 per cent, out of which sum had to come an overhead expense of probably $100,000 and interest charges upon $600,000 to $1,000,000 of working capital amounting to perhaps $25,000 to $40,000 more, leaving a *net profit to the Contractor of substantially less than 2 per cent!*

Broadly speaking, labor costs alone have risen, following closely the local cost of union labor for an eight-hour day, with time and a half or, in some cases, double time for overtime, according to the prevailing local conditions; and even as to these, there are the extenuating circumstances of increased cost of living, the fact that the settlement of the labor rate disputes was not always left to this Board for solution, and, most serious of all, the failure of the Government to adequately control priority of its construction, which would have prevented the bidding up of the local labor markets by its own agents in different departments having contiguous construction underway.

I speak advisedly, not loosely, for the conditions of the work may not equitably be overlooked. They are vital. The work had to be done, *was* done, without delay, and no plea or excuse of inability to get labor, throughout the work, at rates prevailing at its inception, would have excused postponement of completion or have brought back life or treasure spent at the front during such delay.

### CALL COMES FOR ORGANIZATION

On May 17, 1917, Brigadier-General I. W. Littell, then Colonel of the U. S. Quartermaster Corps, was detailed by the Secretary of War to assemble and direct an organization to be known as the Cantonment Division of the Quartermaster Corps, to provide facilities for training and housing the new National Army and the National Guard. He called to his aid Major, then Captain, W. H. Oury, Major then Captain, R. C. Marshall—both of the Regular Army, and Major Dempsey of the Officers Reserve Corps, the former of whom had been supervising the enlargement of some of the army barracks, the second of whom was soon engrossed in the new cantonment construction, and the last of whom took up the question of auditing construction expenditures.

Neither funds nor quarters nor personnel were available for the designated service, for the appropriation bill which carried $77,000,000 for the inception of this work was still in debate in Congress.

This was the opportunity of the Committee on Emergency Construction of Buildings and Engineering Structures of the War Munitions Board of the Council of National Defense. Of the latter Board Frank M. Scott, of Cleveland, was the able chairman.

This committee was made up of five experienced builders: William A. Starrett of New York City, architect and formerly of the building firm of Thompson-Starrett Company, Chairman; C. W. Lundoff, of Cleveland, Ohio, President of the Crowell, Lundoff, Little Company, building contractors; M. C. Tuttle, of Boston, General Manager of the Aberthaw Construction Company; Capt. Wm. Kelly of the U. S. Engineer Corps, who, however, was unable to give much time to the work of the Committee, owing to other army obligations; and Frederick Law Olmsted, of Boston, engineer and landscape architect. To their assistance they called many engineers, city planners, architects and specialists of different kinds, to act on sub-committees or to give desired advice on special subjects.

Circumstances thus made it possible for the Committee to render General Littell service in an advisory capacity on the formation and civilian personnel of his organization, on the form of contract under which the work should be built, on engineers, city planners and contractors of responsibility to design and build the cantonments, and at the moment to make the most of the time which might elapse before the appropriation bill should be passed by Congress, by preparing typical plans or layouts for the buildings and other structures involved, making topographic plans of the sites, studying the water supply, sewerage and other public-service facilities, the best arrangement or grouping of structures, adapting the typical plans to the local topography—all through the voluntary service of achitects, engineers and city planners.

### ORGANIZATION ADOPTED BY GENERAL LITTELL

The organization proposed by the Committee and adopted by General Littell comprised four different groups, reporting to his staff officers:

MAJOR FRANK M. GUNBY, member of this Society and formerly associated with Mr. Charles T. Main of Boston, in *Charge of Design;* assisted by Major F. B. Wheaton, Captain Doten, Dabney H. Maury, Clarence Goldsmith and W. M. Johnson of the National Board of Fire Underwriters, and George Gibbs, Jr., of Boston.

MAJOR ROBERT E. HAMILTON, formerly Purchasing Agent of Stone & Webster, in *Charge of Materials and Transportation.*

MAJOR M. J. WHITSON of Seattle, formerly partner of Grant, Smith & Company, in *Charge of Construction;* assisted by a staff of division engineers, Peter Junkersfeld, Charles L. Parmlee, Ezra B. Whitman and others.

MAJOR DEMPSEY in *Charge of Accounting.*

Since that time, benefiting by the earlier experience and with a view to handling the additional work of building ports of embarkation, ordnance depots, coast-artillery posts, medical department construction, mobile ordnance school barracks, quartermasters' warehouses and miscellaneous plants, the or-

ganization has been enlarged, modified and strengthened, Major Marshall remaining in command under General Littell, assisted by Captains Thompson and Maupin; the engineering branch being still in charge of Major Gunby; the construction of Majors Whitson and Junkersfeld; the materials of Major Willcutt; finance and accounting of Major Dempsey; construction and repair of Major Zollars; the law, Major Shelby; information, Captain Erck; transportation requisitions, Captain Ritchie and Chief Clerk Moreland; and several other engineers of large reputation and breadth of experience, such as Lincoln Bush, Major Betts, Warren R. Roberts, and others, have been drawn into the service, fine examples of personal sacrifice.

The Committee on Emergency Construction of Buildings and Engineering Structures first undertook to get local investigations under way and the preparation of typical building plans. As soon as cantonment or camp sites were designated by the department commanders, approved by the army staff and reported to General Littell, city planners and consulting engineers were asked to go to them, voluntarily and at their own expense, to make topographic maps, study the water-supply and sewage-disposal problems, the location of railroads, roads and other utilities, and to report to Washington with all despatch. Within a week's time, in a number of cases, topographic maps were prepared of areas of from 1000 to 2000 acres, and essential information was obtained upon the points desired. Meanwhile, leading architects and engineers of this section of the country had been summoned to Washington to assist in the revision of the plans for the barracks, the preparation of typical plans, which were afterwards adapted to the local topography, on the ground, by the staffs sent to the individual camps.

### Form of Contract Prepared

Contractors, too, were assembling in Washington to see if they could be of service and the Committee directed its efforts to the preparation of a form of contract under which a work, of the magnitude then contemplated and since largely increased, could be built with reasonable certainty within a time limit of ninety days, in the face of congested transportation conditions, soaring materials and labor shortage.

A form of contract inducing speed was essential. This compelled the elimination of the financial hazard to the contractor, and for the protection of the Government the selection of contractors solely on the basis of experience, merit and integrity. It was at once apparent that the competitive form of contract dictated by past Government precedent was out of the question with the time limit available and the conditions to be faced.

Lump-sum-profit basis form of contract was weighed and rejected as likely to emphasize the idea of barter and trade rather than of fitness and competency, and to embarrass the Government in awarding contracts to more experienced contractors if lower profit basis were offered to the Government by less experienced or less desirable men.

The cost-plus-percentage basis, however, appeared to meet the fundamental requisites and the addition of a limiting lump-sum profit made the Government safe in its operation in the event of substantial increase in the amount of work done under it. The combined efforts of many able men—lawyers, engineers and contractors, as well as of various engineering organizations, produced the "Emergency Construction Contract"—a radical departure from Government precedent—which provided essentially for the construction of the work on the basis of cost plus profit, the latter varying from 10 to 6 per cent with the magnitude of the work, with the important limitation of an upset profit of $250,000, from which sum, however, the contractor had to meet his own office overhead and interest costs. It is interesting and but fair, in the face of some of the unfounded public criticism which has been heard, to note the effect of this upset limit of profit. On the construction of the sixteen army cantonments, involving a total cost of approximately $134,000,000, or upward of $8,000,000 per cantonment, the nominal profit to the contractors will be less than 3 per cent, and after deducting the probable contractor's overhead and interest costs, the *actual profit* substantially less than 2 per cent—in some cases perhaps less than 1½ per cent. Upon the construction of the National Guard camps, involving a total cost of $36,000,000, or about $2,250,000 per cantonment, the contractor's fee is higher, approximately 7 per cent, but as the overhead cost is also proportionately much higher the total return in cash for the six months' period of work is substantially less than in the cantonment construction.

Inasmuch as nearly all of the war construction work now being executed by the Government is being done on an emergency basis, where speed and not cost must control, thinking men will be careful not to criticize carelessly and will weigh fairly the influence of the time element. In the execution of work on such a tremendous scale, under prevailing labor and material cost conditions, it is inevitable that money will be wasted and mistakes made, but the work must be done—expeditiously done—that the saving may be one of lives and days, not dollars.

While the preliminary investigations were under way, the Committee sent out questionnaires concerning contracting firms in this country, seeking references, a statement of the magnitude and kind of work executed during the past two years, the number of men handled and fed at one time, and the financial resources of the concern; obtained the rating of the contractors by important financial-credit concerns, and called to its assistance John H. McGibbons, formerly of the U. S. Fidelity & Guaranty Company of Chicago, to aid it with his broad knowledge of the standing and financial credit of contractors.

### Committee Selects Contractors

Armed with this information a sub-committee of five men, with Mr. Starrett as chairman, selected the contractors deemed best qualified at the moment to undertake the work and who had demonstrated in their past experience their ability to handle work of such a character and upon such a scale; and reported its findings to Mr. Scott's committee of the War Munitions Board. From the latter committee, recommendation passed to General Littell, and after submission of the evidence and recommendations to the Secretary of War, appointment was finally made by General Littell. The subsequent experience in the building of the camps seems clearly to have justified the course of procedure, and it is greatly to the credit of the Government that it can be said, unequivocally and with absolute candor, that these appointments were made on the merits of the case, as they were understood, without political pressure or "influence." It is further greatly to the credit of the leading firms of contractors that as a rule their representatives left Washington before they knew whether they were to be recommended for specific work and before appointments were made, though personal disinterestedness and unwilling-

ness to use political influence cannot be claimed for many others who sought contracts.

The Committee then turned its attention to the preparation of forms of contract for the employment during construction of the engineers and other experts necessary at the camp sites, being greatly assisted in its work by different members of the national engineering societies, who voluntarily came to Washington in response to telegraphic request, to assist the Committee.

Engineers believed to be most competent and at the moment available for service at the various cantonments were also designated, appointments in all cases being made, of course, by General Littell and his staff.

In this way the Government had the voluntary service of many men—skilled in the particular field involved—in building up an effective organization and personnel for the work in hand; men who coöperated in a thoroughly disinterested way with the administrative army board in responsible control. The results attained here seem to indicate the advantage of such a purely advisory board, the recommendations of which could be followed, modified or rejected with cause by the duly constituted executive authorities.

### Details of Camp Construction

Time forbids the attempt to chronicle the details of camp construction executed under the direction of General Littell and his staff. The sixteen National Army cantonment sites were approved at various dates ranging from May 31 to June 27, 1917, contracts for their construction were executed between June 15 and June 23, and work was begun between June 13 and July 6. On September 4, or in less than three months' time, about 450,000 men could have been taken care of at the cantonments, on the first-adopted basis of 200 men to the barrack, later reduced to 150 men; and today, December 5, 1917, the camps are substantially all completed, despite the great increase in construction involved by the prescribed increase in cubical air space per man in the barracks (from 365 to 500 cu. ft.), the addition of remount stations, to care for 10,000 horses at each of the camps having them, hospitals and other changes, which have nearly doubled the work originally contemplated.

The story of the construction of the National Guard camp equipment is similar, except that the work involved is only about one-fourth of that involved in the construction of the cantonments.

A few figures in regard to the magnitude of the work, involved in building the sixteen National Army cantonments, may be suggestive. There were required upwards of 800 million feet, or 37,000 cars, of lumber, and 40,000 cars of other material, a total of 77,000 cars upon the cantonment construction, without allowance for the materials ordered locally and not from Washington—the total involved in the cantonment, camp, and embarkation-station construction to October 31 being approximately 112,000 cars—756,000 squares of sheathing paper, 800,000 of roofing paper, 172,000 doors, 34 million square feet of wall board, 106,000 kegs of nails, 314,000 barrels of cement, 282 miles of wood and cast-iron pipe, 3550 hydrants, 75 miles of fire hose. The total area of land rented or controlled at the cantonments is 261 square miles.

As the construction of the cantonments was drawing to an end the work of this bureau was extended to cover the construction activities of the army, except in a few special cases, such as in the aviation corps, where it was thought wiser by the Secretary of War to leave the construction in the hands of the departments for the use of which the structures were to be built. This new work is well under way, constantly growing and broadening.

### Whole Work Monument of Loyalty and Ability

As one reviews the work accomplished by this cantonment division, he cannot but be thrilled by this fresh evidence of the resources of these United States and the loyalty and ability of its people, remembering how recently and in what manner this bureau was organized; that cantonment construction involved but one branch of governmental activity and one comparatively small group of men; and that similarly inspiring evidences of effective service are to be found in all of its other branches.

If constructive criticism is warranted at such a time, it may be said that one of the greatest needs today, as it was recognized to be six months and more ago, is better coördination of the governmental construction program, ways, means and priority. The subject has been studied in its various phases by many men, but no sufficient authority has yet been delegated to accomplish substantial progress. Effective organizations of thousands of men have been built up with large expenditure of time and money, only to be disbanded on the accomplishment of their specific tasks, when these organizations might have been transferred directly to new tasks, with telling effect, had there but been the necessary government authority to plan well-coördinated effort in its construction field.

In an emergency of the magnitude created by this war, and in the face of the Government's failure to prepare for it, the question immediately arose as to the basic principle which should govern the selection of the agencies to accomplish the enormous task before the Government. Should the governing bodies be creative or essentially administrative? For instance, should the necessary design of warehouses, hospitals, power plants, terminals, nitrogen- and gas-producing works, engine and aeroplane construction, and other work, be executed by old governmental bureaus with greatly enlarged personnel, by new governmental bureaus to be created solely for this purpose, or should it be entrusted, under proper governmental supervision, direction or control, to well-established, adequate and efficient engineering organizations, skilled along these lines and competent to handle the work, of which organizations there were many in the country? Similarly, should the different army corps, with totally inadequate personnel, act as purchasing agencies, or should this highly specialized work be delegated, under governmental supervision, to existing firms of high capacity and reputation?

Mr. Balfour, in his visit to this country, had wisely cautioned against the mistake made and the loss of time incurred by England in building up new bureaus to do the work before the Government, instead of utilizing well-established and live organizations enlarged and controlled by the Government, if necessary, to the end not only of saving time and expense, but also that when the war was over the gigantic work of reconstruction and readjustment might be facilitated by the enlargement and strengthening of these existing private or corporate agencies, instead of being retarded and hampered by their disruption.

The Committee on Emergency Construction had this thought clearly in mind and predicated its efforts on the three hypotheses:

1 The work must at all times be under the superior control of the United States Government, through its duly accredited representatives

2 Services must be equitably compensated

3 Government methods of contracting for and compensating construction work and services should be such as to utilize and strengthen and not to impair or destroy existing organizations.

Unfortunately, the Government has not carried this principle as far as it might advantageously have done, but has in a number of cases built up in Washington and elsewhere new agencies for executing work instead of employing existing ones competent to render effectively the service desired, thus failing to benefit by the mistakes of England and France and the helpful advice of Mr. Balfour. But, on the whole, and in spite of the waste thus involved, surprisingly rapid and very commendable progress has been made.

# BUSINESS MEETING

## Address by President Hollis on Society's Activities—Presentation to Society of Bust of Rear Admiral B. F. Isherwood—Award of Prizes for Papers—Appeal for Mechanics for Ordnance Department

THE annual business meeting of The American Society of Mechanical Engineers convened in the Auditorium of the Engineering Societies Building on the morning of Thursday, December 6, at 10 a.m. The meeting was called to order by President Ira N. Hollis, who delivered a forceful address upon the activities of the Society for the year 1917. In this address the President laid before his hearers a clear conception of the internal and public activities of the Society. He presented a detailed statement of the work of its Council, committees, sections and branches for the year. He described the nature and magnitude of the Society's service to the public in the war, and defined the extent to which he thought the Society could continue to render such service. The text of the President's address is appended to this account.

The Secretary said he was sure that every member would be glad to express his appreciation of the tremendous devotion of the President to the work of the Society in the past year and of the energy which he had displayed in discharging the many functions and duties of his office. He then presented formally the reports of the Standing Committees for the year, which were published in the December issue of THE JOURNAL, discussing each one in turn in detail. He pointed out that the income of the Society had risen in the last few years from $50,000 to $230,000 a year, during all of which time the activities had been continuously extended. The Society was in a unique financial condition—it had not a single dollar of indebtedness of any kind outstanding, and moreover had $50,000 invested in bonds, $21,000 in banks and $10,000 of the First Liberty Loan and $10,000 of the Second Liberty Loan—all put away against emergency. These splendid results were due to the consistent, business-like attention to our activities on the part of Mr. R. M. Dixon, Chairman of the Finance Committee, and Mr. I. E. Moultrop, Chairman of the Increase of Membership Committee. The Meetings Committee, under the chairmanship of Prof. R. H. Fernald, had devoted itself assiduously to its work, as attested by its wonderful progrom for the Annual Meeting. The Publication Committee was striving to make the publications inclusive of all engineering and the most pertinent to mechanical engineering.

Five amendments to the Constitution were next presented by Prof. F. R. Hutton, Chairman of the Committee on Constitution and By-Laws. These amendments were first presented at the Spring Meeting in Cincinnati in May 1917, and were published in the October issue of THE JOURNAL. Each amendment was, by vote of the meeting, ordered put to letter ballot.

The first amendment was to bring the Constitution into accord with the New York State Law and to make the quorum in the Council a majority. The second amendment was to provide that administrative committees be officially represented in the Council, the Standing Committees on Administration to be Finance, Meetings, Publications, Membership, Local Sections, Constitution and By-Laws. The third amendment provided for the appointment of such annual committees as might be required from time to time. The fourth amendment was for the purpose of enabling the Society to meet its greater responsibilities in public matters, while still excluding discussions of partisan politics. The fifth amendment was to remove the present bar to the approval or adoption by the Society of any standards presented through its committees or otherwise; heretofore standards have always been received, but not approved or adopted.

The next business was the award of the Student Prize for 1917 to H. R. Hammond and C. W. Holmberg for their paper on A Study of Surface Resistance with Glass as the Transmission Medium. A report of the committee on this award was made by Professor Hutton, who also presented the prize. Professor Hutton said that there was a pathetic note to be added to the report—the Society had just received information of the death of Mr. Hammond. Mr. Holmberg was present and received his prize in person.

At 11.00 a.m., while Professor Hutton had the floor and was presenting the amendments to the Constitution, the President interrupted the proceedings to introduce Lieut. B. C. Detchon, who made an eloquent appeal on behalf of the Military Engineering Committee of New York for help for the Ordnance Department—the mechanical-engineering department of the Army—which he said was in urgent need of mechanics for repair work in France. He suggested that each member present deprive himself of some of his men for the time being to supply this immediate need.

Lieutenant Detchon also appealed for aid, personal and financial, for the Military Engineering Committee, whose activities in connection with the war were manifold.

Prof. A. L. Williston called attention to the number of trained men who will be needed in this crisis, and pointed out the opportunity which colleges and technical schools have of serving their country through putting at the disposal of the Government not only their technical equipment, which is immensely valuable in this emergency, but their teaching experience, which is indispensable.

He made a motion that the Council immediately appoint a committee to investigate whether coöperation between the War Department and the technical schools cannot be started immediately to put into effect training schemes for technical men for the War and Navy Departments, which was carried. The

motion was discussed by Ralph E. Flanders, Prof. L. P. Breckenridge, the President and the Secretary.

Following Lieutenant Detchon's appeal, an impressive ceremony was held of the presentation to the Society of a bust of the late Rear-Admiral Benjamin F. Isherwood, Honorary Member. The presentation was made by Mr. William M. McFarland, Past Vice-President, and the bust was unveiled by Benjamin F. Isherwood, grandson and namesake of the Admiral. President Hollis accepted the bust on behalf of the Society, taking the opportunity of paying his own personal tribute to the genius of this great engineer. Mr. McFarland's and President Hollis's remarks will be found on a following page.

The business meeting was followed by a Local Sections Session, an account of which is given in the Society Affairs section of this issue of THE JOURNAL.

## ACTIVITIES OF THE SOCIETY FOR 1917

BY IRA N. HOLLIS, PRESIDENT

THE past year has been of such vital influence on the future of our profession, as well as of our country, that I desire to lay before the members a brief report of our activities and our possibilities for the future. This is not intended to replace the annual report of the Council, which is a detailed statement of all business during the entire year. The only regret I have is that the completed Council report has been delayed to permit me to make such extracts as seemed necessary toward a consistent comment upon it. The reports of Committees are, of course, in print for this session. It seems wise, on the whole, to bring the Society up to date in a general way.

The American Society of Mechanical Engineers was organized in 1880 for the purpose of promoting engineering science in every way. At that time mechanical engineering was hardly recognized as a profession. It was never distinctly a part of civil engineering, but grew out of the modern demand for men to take their places in industries and manufacturing. The few who practised mechanical engineering in the early days were essentially designers of machinery or investigators, like Leavitt and Thurston. Consequently, for many years the papers of the Society were confined to technical and educational subjects for the benefit of its members, and through them for the benefit of the public. Our Society is fundamentally educational, and that must always be its chief function if it is to continue as a society for the advancement of applied science. Through the influence of the engineering colleges and the rapid advance in manufacturing, the profession has changed, and the mechanical engineer is no longer tied exclusively to technical questions. The old guard has given place to consulting engineers who deal with industrial and power questions on a large scale, and with the management of great industries, leaving the details of design and construction to thousands of young engineers who have been absorbed by manufacturing and operating companies. We must recognize also that mechanical engineers have by training and experience become leaders in business, especially in business connected with manufacturing.

### SOCIETY HAS RESPONDED TO CHANGES IN CONDITIONS

To this rapid change during the past generation, the Society, while holding to its original purpose of advancing engineering through the discussion of scientific papers, has responded in proportion to the demands of the members, to the vision of its officers, and to the needs of the country, exactly as the constitution of the United States and the governments of our commonwealths have been made to fit a growing population and a larger understanding of coöperation. While there have been differences of opinion on all kinds of subjects (and no society is in a healthy state unless there are differences of opinion), and while we may have missed some opportunities for usefulness, on the whole our Society has not failed of its duty to the country. We have never been leaders of propaganda on political and social reforms, and we cannot be without running the risk of losing our character as a scientific organization or splitting up into cliques that would destroy one another. On the other hand, our annual meetings have provided a forum for discussing and assisting great advances in industrial organization and in the art of manufacturing. It is here, for instance, that papers have been presented on a wide range of subjects, extending from test codes for power and the boiler code for the construction of safe boilers, to standardization, testing of materials and scientific management.

The attitude of the Society, as a whole, is well indicated by the character of the men who have been elected to the governing boards. They have invariably been friendly to the coöperation of the engineers with the public in the proper development of our material resources, and have been both sympathetic and responsive to the desires of the members. In going about the country during the past year, which I have done systematically as part of my duty while president of this Society, I have never heard a word of complaint against the Council or their methods, excepting in a very few cases, unhappily, open to suspicion of an unbalanced judgment. Our Society does not stand for that.

We must remember that in a national society covering the vast range of territory we have in America, there are many scattered groups that seldom come in touch with one another. The general headquarters must necessarily be in some one locality, and New York was long ago chosen as perhaps nearer the center of the enterprise of the world than any other city. The Atlantic Ocean is nothing now, and New York places us in almost the center of gravity of manufacture. Nevertheless, a group of our engineers in San Francisco, for instance, is far removed, and they seem sometimes as if they were not genuinely a part of the national society; but it is a mistake to feel any isolation. Every member of our Society ought to know that he is very likely to get out of the Society what he puts into it, and any effort toward improving the Society or toward educating its members through scientific papers or by contribution on broad, general questions is quickly recognized.

During recent years the Sections of the Society have been regularly organized, and the Sections Committee has been established to encourage activities within every Section. There is a session at this annual meeting that will bring their representatives together for a concerted study of how to make the Society reach out even more effectively to every one of its members.

### DEMOCRACY OF THE SOCIETY

The democracy of the Society cannot successfully be assailed. It has been suggested that the president has it within his power to continue his own influence by appointing his own kind of a nominating committee for the officers to succeed him. To use the language of the street, this is absolute

rot. It has not been the custom for the president or the officers to influence the choice of the new Council members, and almost invariably the whole Society has been solicited for suggestions. The consistent tendency is toward a greater participation of the members, and therefore toward greater democracy as we learn how to be wisely democratic. This Society is not an assemblage of the "bandar log," ready to chatter over the latest fad, but a union of men sincerely interested in benefiting their country through science. That we must always remember in scanning proposed reforms.

Furthermore, the Society is in the hands of its members and not in the hands of a few corporations. We must not permit ourselves to go to an extreme because corporations have sinned in the past, and because they are going to sin in the future. The directors of all corporations are human as our directors are human, and they will make mistakes over and over again, and we will help to correct them over and over again, but our Society is not a creature of any public-service corporation, and it never has been. It stands for truth in science, and it ought to help the truth in the social life of the country. Its purpose, however, is the truth in science and not a partisan conception of the truth.

One has only to take a list of the officers who have served our Society to find that all aspects of modern industrial life have been wisely represented. There is no earthly reason why our Council should be organized as the enemy of the men who conduct our great affairs, nor should it be organized as their special advocate. It is organized for the truth and nothing but the truth. Consequently, we should not as a Society permit ourselves to be led away by catchwords, nor should we permit ourselves to be fooled by a list of our mistakes. We know that no human institution ever can be freed from imperfection and mistakes will always be made, and in our country, thank God, will always be corrected.

### The Society's Public Relations

It is sometimes difficult to determine how far the Society ought to go in its public relations. At this time, while we are at war, there is no limit to the sacrifice that ought to be made to the common good, and to the work that ought to be done by the members individually and the Society as a whole toward the success of our country in war. There is a difference, however, between individual activity and collective activity. This is the time when the individual can offer himself, and when the Society can best serve as simply the intermediary for assisting the individual to serve well. That we have systematically tried to do. At the present date, fully ten per cent of our membership is in service. In ordinary times of peace it is sometimes a question how far we ought to depart from the orderly discussion of technical and scientific papers. We have the right by our charter at any time to enter into legislative questions or into any of the great economic questions before the country. We have no right to take part in partisan politics, either from the point of view of the legality of our charter or from the point of view of policy with regard to the future development of our Society.

We have taken part in many things of public interest and in many things involving the public. For instance, in our Boiler Code we have affected legislation in many of the states and municipalities. In our Committee on Standardization we have done a great deal of good work, culminating finally in a general Standardization Committee to represent many societies so that we may work together. In our Test Code for Power we have had a very wide influence throughout this country on the development and design of power stations. It is not necessary here to go into the details of our activity, but I think it is easy to make evident the fact that our Society has always been one of public relations.

In connection with public relations there are sometimes great differences of view on the part of engineers generally. I have been disposed to ask the question, "Is it right that any one society of engineers should take a stand on any public question that affects all engineers without a full discussion of the subject with other engineering societies?" The engineers have only slowly come to a proper representation of themselves before the public. If we are to have our legitimate influence over public affairs we all must act together. It is only common sense then at least to thrash out subjects before a senate of the engineering societies, or what we have called an Engineering Council. To that end the American Society of Civil Engineers, the American Institute of Mining Engineers, The American Society of Mechanical Engineers and the American Institute of Electrical Engineers have joined together to form the Council for considering all matters referred to them by a single society or by our Government. It is the only method of taking up public affairs. Consequently, we may well ask ourselves the question at the present time, "How far ought any single society to act alone?"

### Our Activities for the Year

I am glad to call attention to some of the details of our activities during the year. The election of Major-General George W. Goethals as an honorary member adds one more to the long list of distinguished men who have had membership in our Society. This kind of membership has never been refused, and it is rightly regarded by us as the highest acknowledgment we can make to great service in engineering. The regular membership of the Society has been steadily increasing, mainly due to the efforts of the Increase of Membership Committee and to the good standing of the Society as a useful aid to engineers who are going into mechanical engineering.

The Local Sections all over the country form a very important adjunct in this regard, and the administration has been wise in permitting them to invite non-members of the Society to all meetings. The coöperation of these Local Sections is encouraged in every way, in order that they may have touch with the sections and branches of other societies. Every engineer in the United States ought to have membership in a national society, and also some relation to the local sections or local societies. It is the only method by which we can be drawn together as engineers.

Attention is called in the Council report to the number of Local Sections in the country. There are twenty-two, one of which is a state Section, with five branches. This is a very interesting departure from former practice, and promises rich developments in the future. Every state could have its organization of engineers, with branches in the principal cities. Our Society would accomplish much good by fostering that idea.

It is not necessary for me to refer here to the Cincinnati meeting beyond the remark that it will go down in the history of our Society as one of the great meetings where Cincinnati outdid herself in the entertainment of her visitors. We met with the Machine Tool Builders' Association, and the meetings are rightly emphasized in the report submitted by the Council.

The Student Branches hold out possibilities for excellent coöperation between the colleges and our Society. This has not been developed as fully as possible, and we should, by

visits to the colleges, by coöperation with the Society for the Promotion of Engineering Education, and by a better acquaintance with the faculties, lend all possible aid toward the better education of men who are going to come into the profession of engineering. We ought to have some systematic part in education.

### OUR BIG WORK OF CLASSIFYING ENGINEERS

There has never been a more important year to our Society than the past, during which war has been declared against a strong combination of nations and the country has been called upon to form and equip a large army. We have all been eager to serve in some way. At the same time, the place for service has not always been self-evident. In the inevitable confusion, no system was adopted by the War Department or by the Navy Department in the organization of men for commissions in either service. Orders were issued and recalled for a great variety of things, so that even at this time an engineer is puzzled where to apply. Our Society has done something to help in this situation, but not all that might have been accomplished under more favorable conditions. We have joined with other societies in the Engineering Council to form a committee for tabulating the members of our Society as to their attainments, their previous experience and their willingness to serve. This committee, with George J. Foran as chairman, has done yeoman work in devising an admirable system for obtaining the information required. Inasmuch as the tabulation is a long-time piece of business, they have quickly listed several thousand names from the various societies as specialists along various lines. The names have been submitted to the departments of the Government and to the industries generally as they have been requested.

It has been very puzzling to know just how far the Society could go, as the responsibility for the selection of men and for the suggestion of the needs of the service must rest with the commissioned officers of the army and navy, under orders of the President. Wherever the Society has been requested to lend its aid in the procurement of men for commissions for special service in civilian lines, or for the formation of regiments, it has gladly responded, always supplying more names than were needed in order to be absolutely fair with all members. The members of the office force, from the secretary down, have had a full realizing sense of the obligations on the part of all of us to serve in every way and to help in the formation of an army so that our country might be most speedily prepared.

The tabulation of engineers, if carried through all the societies, national and local, will be a directory of American engineers. It should be catalogued and cross-catalogued for names and branches of the profession. There should be at least two copies, one filed in New York and one filed with the local society in which a member is resident. Such a directory can be made useful in the readjustments of our industries in peace after this war is over and in the better organization for the conduct of business. The United States never has been able to coöperate well in industries. In fact, such coöperation has been discouraged under the idea that it might in some way defeat competition, which is said to be the life of trade. Nevertheless, coöperation ultimately means exchange of information, and a resulting reduction in the cost of everything that we make.

There is another aspect of this, so far as the individual societies are concerned. Every society, and ultimately the Engineering Council, ought to provide some method to assist the younger members. An employment office is a perfectly legitimate part of our activity, and, as a matter of fact, it has been carried on by The American Society of Mechanical Engineers for many years, to the great satisfaction of many men who have found positions through the office here in New York.

### THE SOCIETY AND STANDARDIZATION

Reference is often made to standardization, in which our Society has taken a very active part for years past. The committee appointed to act with other committees will assist in placing the development of commercial standards among the men best able to pass upon them. The example of the Society of Automotive Engineers should stand as an inspiration to us toward the establishment of all kinds of commercial standards to facilitate manufacture; although it was much easier for that society to promote standardization in the automotive manufacture, because it was one of the methods by which they could get their orders filled. Where the steel industries were called upon to provide hundreds of different kinds of steel, many of them for the same purpose, and hundreds of different dimensions, where comparatively few would have sufficed, it was imperative that the manufacturers should get together, and they have done this effectively. Our Society stands at a disadvantage with respect to standards, as it has nothing of the commercial about it, and no method of forcing upon any manufacturer its findings with regard to standards. We depend, then, upon the slow process of persuasion.

One of the aspects of standardization appears in the controversy over the metric system. There is much difference of opinion about the wisdom of replacing the English units with the French units. Many sincere men believe that we ought not to make any change. Others believe as strongly that we ought. It would be wiser, on the whole, for the Society to maintain this place as a forum and to keep out of this controversy as a society until the way seems more clear. That will not prevent any member of the Society or any group of members writing on the subject, under the encouragement and for the benefit of our membership and for the benefit of the country.

One of the industries that has grown with remarkable rapidity in the past few years is that pertaining to gages of all kinds for the manufacturing of munitions and other supplies. Gages are as necessary in time of peace as they are in time of war, but not in such great quantities. The mistake made by the Government has been the neglect to accumulate a large stock of gages. Last spring in Cincinnati very strong representations were made to the departments in favor of a central locality for the comparison of gages and for certifications as to their correctness. Congress appropriated a large sum and authorized the Bureau of Standards to take on, as part of its function, the comparison and certification of commercial gages of all kinds. This is a radical departure, and it should lead to a great improvement of manufacture in many respects. Our Society has appointed a committee to serve as consulting engineers for the Bureau of Standards in connection with this new departure. We as a society are prepared to assist the Bureau, which is doing such fine work for the country.

Another question which has come up during the year grows out of a request on the part of the Bureau of Mines and the fuel administration to assist in fuel conservation. The whole subject was referred to the Engineering Council, and through the Council consulting engineers have been appointed for the Bureau of Mines to advise in regard to the technical matters connected with fuel conservation and with the use of fuel. A

committee was also appointed at the invitation of the United States Chamber of Commerce to serve with a general committee on the whole general question of fuel. During the year, committees of our Society were also appointed to assist the Bureau of Mines in various ways, but inasmuch as the war has seriously interrupted the development of the new laboratory in Pittsburgh, these committees have been inactive. Their time will come, however, and they will be able to do for our Government the work that this Society is glad to give.

### OUR VARIED BUT VITAL ACTIVITIES

It is not necessary to refer at any length to the service of the members of our Society in the army and navy. At this time, John H. Barr, W. B. Gregory and Max Toltz of the Council hold commissions as majors in the army, and are serving in important positions. The Society itself has sent so many to the colors that we would find it difficult to tabulate them here. In fact, it is doubtful if we shall have a complete list until after this war is over. Those serving for the Naval Consulting Board and in other capacities are helping splendidly, even though they are occupying positions less spectacular than those on the lines.

The year has seen an innovation in connection with the meetings of the Council. We held in November a meeting in Chicago, in order to test the value of meetings outside of New York. It seems only right that the larger Local Sections at least should have an opportunity to meet all the members of our Council; not only for their own satisfaction, but also to inform them about the needs of the localities. It is hoped that this plan of meeting in the different large cities from time to time may be carried out in the future. The meeting in Chicago was a great success, as it brought together a very large number of the mechanical engineers. The visiting of the various Local Sections by the Committee on Sections is also an important move in making our members better acquainted with one another and it is quite certain that the journey made by the Committee this fall was useful.

One of the valuable elements of the work in the Engineering Building relates to the Library, in which all the societies share. There is no respect in which we can make our distant members feel more interested and benefited than in giving them access to the library by correspondence. Any member ought to feel free to write for a synopsis of any article or for a search, at a minimum cost, and the library should have duplicates, in order that books might be loaned. They could be sent by express to different parts of the country for use, to be returned within a specified time. This is the practice in many other libraries and it could be made very useful here.

The Power Test Committee, under Mr. Barrus, has long been giving its attention to the details of all kinds of power tests. The usefulness of their work in the past has been amply proven, and every effort should be made to assist them in perfecting the code. A hearing and a discussion in our building has been encouraged. Its results should be bountifully fruitful. It must be remembered, however, that no one group of men will know all power tests. Consequently, it seems advisable to invite sub-committees to work out the different kinds of tests. This has been planned and it is hoped that by advisory boards and sub-committees we may improve our test code.

This Society and the whole engineering world owes a debt of gratitude to the members of the Boiler Code Committee, whose patient work has benefited us so much. The Code is operative in many cities and eventually it will probably apply throughout the whole of the United States, thus promoting the safety and welfare of many men.

I call attention to the printed report of the Council, which will be issued later, for a fuller statement in tabulated form of all that we have done. The development of THE JOURNAL as a means of placing important papers most quickly into the hands of readers is extremely gratifying, and under the direction of the Publication Committee and Mr. French's excellent management it has disclosed many unexpected possibilities. The question may well be asked why we continue to publish the TRANSACTIONS as a separate octavo volume when the whole of our activities may be printed in THE JOURNAL. No foreign society ever publishes duplicate transactions. If some way could be found of making THE JOURNAL a mouthpiece for all of the societies, the bulky volume issued annually for each society would have a natural place; otherwise, the extra twenty thousand dollars spent by our Society might be saved to make THE JOURNAL better.

I cannot close this brief report without a cordial acknowledgment of the politeness and consideration that I have received from Sections and members of the Society. It has been a pleasure instead of a task to serve them as president. The patience and kindness of the office force could not have been surpassed and the untiring zeal of our Secretary, Mr. Rice, for the good of the Society and of our country deserves the warmest acknowledgment from members and their officers.

## Presentation of Bust of Admiral Isherwood

### ADDRESS BY W. M. MCFARLAND

THE honor and pleasure of making the address in presenting the bust of Admiral Benjamin Franklin Isherwood to the Society was assigned to his old friend and assistant, Commodore George W. Magee, U. S. Navy. Unfortunately, the Commodore has fallen ill, so that this honor has been delegated to me. I am sure that you will all regret as sincerely as I do that we are not to have the pleasure of hearing from his own lips the tribute of this venerable man to his former chief, whom he loved and esteemed so highly.

Fortunately, we have a copy of Commodore Magee's proposed address, which I shall read you in a few minutes; but as the opportunity is afforded me, I wish to pay my own small tribute to the great man whose memory we are honoring today.

It will always be a source of satisfaction to me that I met him a number of times, and once had the pleasure, while I was a youngster in the Navy, of doing a little work for him. My admiration for his genius and ability came from acquaintance with the work he had done, as shown in the published records; but more particularly from an intimate acquaintance obtained from older officers who knew him and all his deeds well.

Supplementing Commodore Magee's address, and remembering that our esteemed President, Doctor Hollis, was also a naval officer, and an admirer of Isherwood, I would emphasize the importance of his scientific work as a pioneer.

In these days of technical societies, great technical journals and splendid textbooks, when the general principles of the science of engineering are so thoroughly established, it is difficult for us to remember that there was a time when many of these principles were either unknown or were considered to be debatable. It is the special glory of Isherwood that he helped to establish a number of the most important of these basic principles.

As showing the state of the art in his early days as an engineer, it may surprise you to learn that a rather careful search through engineering literature showed that the first reproduction of actual indicator cards from a marine engine published in any book was given in Isherwood's work, entitled Engineering Precedents, published about 1856.

Just another word about the enduring value of his work. His reports of experiments are models of what such reports should be. They include a complete description of the apparatus; and the log of the experiment, in each case, gives all the data which could be observed, whether they were immediately applicable to the purpose of the experiment or not. The result of this is that these reports constitute a mine of valuable information; and other engineers, many years after, seeking information on an entirely different line from that for which the experiment was conducted, find in the complete and careful record just the information they want, and which often can be found nowhere else.

Isherwood's wonderful work and personality had so impressed itself upon the older men of the Engineer Corps who knew him well, that to all of us younger men he became one of the heroes of engineering. We worshiped him at a distance. Our dear old friend, Commodore Magee, was his intimate personal friend for more than half a century; and I now have the pleasure of reading his tribute, which I so greatly regret that he could not make in person.

## Tribute by Commander Magee

THE pleasant duty has been confided to me of saying a few words in the presentation to the Society of a portrait bust of Admiral Benjamin Franklin Isherwood, U. S. Navy, who was for many years, until his death, one of your honorary members.

This duty is all the more pleasant from the fact that during my active service in the Navy I was associated with Admiral Isherwood during several tours of duty, and especially during that trying time of the Civil War, when he was Engineer-in-Chief of the Navy. I was a young man then, as indeed was Isherwood himself, and I worked for him with all the enthusiasm which a young man feels when he is in constant touch with a great genius and administrator. He honored me with his friendship, which lasted unbroken until his death.

The work by which Isherwood is best known among engineers throughout the world is his splendid series of experimental investigations. The most famous of these perhaps were the ones on the *U. S. S. Michigan* in 1859, to investigate the expansive working of steam. His screw-propeller experiments at Mare Island, in 1868, have, however, been praised just as highly by those who found them a perfect mine of valuable data.

He availed himself of the great shipbuilding program during the Civil War to make further experiments on expansion, on the use of superheated steam, and on the use of forced draft, to mention only a few of the many. The great value of this experimental information was so thoroughly appreciated by the profession that the results were published in book form by subscription.

Isherwood was a wonderful engineer. Loving him as I did, I may be pardoned for saying that I think he is the greatest marine engineer who has thus far appeared in our country. I fear that it is not appreciated as it should be, however, that he rose fully to all the responsibilities of his great office and was not only a great engineer, but a great administrator and executive.

When the Civil War was over he was criticized by good men who were engineers, but not administrators, on the ground that the machinery of our naval vessels during the Civil War was unduly heavy. They forgot, what Isherwood remembered, that his duty was not to provide the lightest machinery—with possibilities of breaking down in the hands of inexperienced men—but to provide machinery which would not break down and which would enable our vessels to be always ready to answer every call upon them. Many of the brave men who volunteered for service as engineers during the Civil War had little or no experience with marine machinery, and to have designed the engines which were to be entrusted to their care according to ordinary methods would have been almost certain to invite disaster. As a matter of fact, the machinery did not break down, was highly satisfactory, and carried our flag to victory. To my mind, this is one of the greatest glories of his career.

If time permitted I would love to go into detail about this remarkable man, telling of his broad general culture, his interest in art and music, and his remarkable felicity in the preparation of engineering papers. The older engineers in my audience know these things, and the younger ones can learn by reading what he wrote.

He retained his mental faculties in their full vigor to the very last, when he was more than 90 years of age. On one occasion, only a few years before his death, I was with a party of younger engineers who had called to pay their respects. We were all amazed at the wonderful range and accuracy of his memory, and even more at his intimate knowledge of the engineering questions of the day. His remarkable gift of fluent and lucid speech was strikingly evident, and we felt that we had enjoyed one of those rare treats where the wisdom of the sage is clothed in the elegant diction of the accomplished scholar.

A number of his friends and admirers, with the hearty approval of his family, believing that there could not be a more fitting place than the rooms of this Society for its permanent location, have commissioned me to present to the Society this portrait bust of the great engineer. Here, it is in fitting association with other busts, paintings and photographs of the leaders of the profession, many of whom were his contemporaries and by all of whom he was held in the highest esteem. And here, while engineers of the future gaze upon the features of this famous master in their calling, they may reflect upon his achievements which have added luster to the profession, especially as a great engineering executive whose genius contributed so essentially to the carrying of our flag to victory.

## Dr. Hollis's Acceptance of the Gift

LADIES and Gentlemen, my old friend who sits on the stage, I accept this bust on behalf of our Society, to be placed in our little hall of fame that we may carry memories on to those who are going to follow us in this Society. It is with a certain amount of emotion that I personally stand here to accept this bust, because I knew Mr. Isherwood when I was in the Naval Academy, and I served him in a similar way, after graduation, as Mr. McFarland served him—the proudest service, perhaps, of my life, and one of my great memories is to have seen him and known him and known that charm to which Mr. McFarland has referred. I think of him as perhaps the father of our great research laboratories in engineering, as his investigations in connection with steam engines and with boilers preceded all of our schools of mechanical engineering.

I think of him also as the father of high speed on the sea.

Few people realize that it was Benjamin F. Isherwood who during the Civil War planned and carried to its completion the first ocean greyhound, a ship which went outside along the Jersey Coast and made four hundred miles in one day with ease, something that was not equalled again for twenty years. With a certain characteristic slowness in carrying things to completion, his ship, built to run down the *Alabama*, was not completed until the *Alabama* had been run down by another ship.

I think the rooms of this Society constitute a fitting place to put this bust as the example of a great man who can stand to us as a double father, the father in research engineering and the father of ocean navigation. I thank, on behalf of the Society, the family which has contributed this bust, Mr. McFarland who has made the presentation, and the small boy who has unveiled the bust, for giving us this treasure to be carried upstairs and placed in our rooms.

# MANAGEMENT SESSION

## Important Papers and Discussion on Some of the Modern Problems of Management, Including the Woman Worker in the Skilled Industries and the Re-education of the Crippled Soldier

THE American Society of Mechanical Engineers helped to contribute to the solution of war problems of the day by holding on Friday, December 7, an all-day session on the subject of Management. The morning was devoted to the vital question of the Employment of Women in the Skilled Industries. A paper was presented by John W. Upp, of the General Electric Company, on the Woman Worker, and an address was given by C. B. Lord, of the Wagner Electric Manufacturing Company, on the Psychology of Environment. Invitations had been extended to manufacturing companies throughout the country to send representatives to the session or to outline their practical experience in the employment of women on the questionnaire prepared by the Society. Representatives from many manufacturing plants were present, who added to the discussion by relating the very interesting and enlightening experiences encountered by their respective companies.

The paper by Mr. Upp is here given in full, and is followed by the remarks by Mr. Lord and an abstract of the discussion at the session.

### THE WOMAN WORKER

By JOHN W. UPP, SCHENECTADY, N. Y.

EARLY in 1917 it was necessary to materially increase our manufacturing facilities in one line in which the writer is particularly interested. It was evident that we could not obtain enough men employees to operate the equipment which was purchased for these increased facilities; we could see that this lack of sufficient men employees would continue and increase rather than decrease our difficulties; and we knew we could obtain men for our facilities only if we withdrew them from other manufacturing departments or companies which were occupied on actual or related Government work. After thoughtful consideration we decided to make a definite attempt to use women operatives instead of men on all classes of machine work. Our plans were made accordingly, and the accompanying photographs will give you at least a little conception of the work that these women are doing for us.

In our minds, and in yours no doubt, there has been a feeling that women are not suited to operate complicated machine tools or to do the work that is required in a modern and high-grade machine shop.

Thus the solution of the first problem, What can a woman do? would determine the measure of her value to us. The answer is extremely interesting and satisfactory, for we have found women under proper conditions and with proper training almost, if not quite, the equal of men on the work to which the women have been assigned.

We have been much surprised at woman's strength and endurance and are now willing and ready to assign her to duties which were until recently assumed to be entirely beyond the scope of her ability. She is remarkably quick to learn. With only a short intensive instruction many women are working at duties which we would only give to apprentices of two or three years' training.

We have found, however, that it is necessary to recognize some fundamental difficulties if women are employed in these unusual occupations. In considering her ability to successfully withstand work in the factory, it should be remembered that she is not so strongly built as a man, that she is not so tall, that her reach is not so great, that she cannot stand so long, that she is unsuitable for the lifting and carrying of heavy weights, and that she must have a great many conveniences that men do not require. Thus it has been necessary in all our machine operations to greatly change our methods of handling the work. This is so arranged and the carrying trays so constructed that it is impossible for a woman to obtain a load that is greater than 50 pounds, except where the size of an individual piece makes such a limit impossible. Stools or chairs are provided where possible and short rest periods have been found to be advantageous in many cases.

All the states have quite stringent regulations in reference to rest rooms and hours of employment for women. We have always felt that it was desirable not only to live up to the letter of such laws but to provide facilities beyond those which were required, because most encouraging responses have been made when we provided additional facilities and conveniences.

We do not feel that any employer should encourage women to work in his shops unless the conditions are suitable for such employment, and that a very serious error will be made if employers put women to work in the machine shops under conditions which men are willing to endure.

In hiring women, especially for tasks which are new to them, several points should receive their proper share of consideration so that both the company and the employee may benefit by the partnership.

Careful attention must be given to the character of the

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women employed and more thorough investigation must be made of their references than in the case of men, for the employment of one undesirable woman will frequently destroy the usefulness of a large department. All the women working in any section must be acceptable to the other women or resignations with or without explanation will be apt to take place rapidly.

We also found early in our experience that women between the ages of 18 and 31 are more adaptable and learn more quickly than those who are younger or older—those who were younger than 18 not having reached a period of

WOMEN OPERATING SCREW MACHINES

physical development which warranted their undertaking strenuous factory work, and those who were older than 31 being so fixed in their habits that they do not learn quickly enough to suit our purpose. In this experience, however, the employment of women has not differed materially from what it would be if we were employing men under the same conditions, for it is probable that if we completely changed the environment of men they would not be easy to instruct unless they were within the age limits specified.

We have not made any attempt to discriminate between unmarried and married women, except that we have investigated every acceptable applicant with minor children to assure ourselves that she had means of having her family taken care of while at work in the factory.

We begin to train a woman for her duties immediately after she goes to work. We never add many women to a department at one time, as we have found it impossible for an instructor to give to each of many new employees sufficient attention to obtain satisfactory results. If we take on too many women at once it is necessary for them to wait some time for instruction. In this interval they become discouraged, impressed with the thought that they will never learn, and usually nearly all those who have not been given the undivided attention of the instructor during the early days of their employment, resign, apparently having reached the decision that the work was going to be so difficult that they could never learn how to perform it. But when the new employee can be given the undivided attention of the instructor and can have the operations explained until understood, there has been laid the foundation for a probable permanent employee, and one whose work will in almost every case be satisfactory. We attempt to instruct two women at one time on each machine tool, giving them alternate opportunities to operate the machine tool themselves, but under the immediate and direct supervision of the instructor who is assigned to that particular job.

We found early in our experience that we had a smaller percentage of failures when our women employees came from the industrial walks of life, that is, from families in which the husband, brother or father was a mechanic. The women then understood many of the machine operations, particularly if they had a sewing machine at home or were familiar with modern household apparatus. If we drew our prospective employees from those walks in life where the men of the families were engaged as bookkeepers, clerks, or on similar work, the women had to receive much more instruction and they were more easily discouraged.

We find it difficult to teach women to operate screw machines, but when they learn, their work is as satisfactory as that of men; and on the lighter screw-machine work we are having the remarkable experience of finding their work more productive than that of men. We do find it difficult to teach women how to operate milling machines and we have had many failures, yet we have women operatives on milling machines doing high-grade work as efficiently as it can be done by men. We have found it difficult to teach women to operate lathes, but now have good women lathe operators in our employ. It has never been difficult to teach women to operate light punch presses, and although we have always considered heavy-punch-press work a man's job, we now have women operating heavy punch presses in an entirely satisfactory manner. We have always considered the assembly work on some of our more important operations as being essentially the work of the man who had been trained

TYPE OF CLOTHING WORN BY WOMEN ENGAGED IN SHOPWORK

as a mechanic; but we now find that when properly instructed, women can do this work in a way that is entirely satisfactory to us.

It has been necessary to more closely supervise and inspect the work turned out by the women than by our regular run of men employees, for few women have any conception of the importance of dimensions, or any judgment as to mechanical strength or requirements. Therefore, they work by instruction rather than from any inherent mechanical knowledge. But you can be sure that once a woman employee is taught how to use a gage or learns what constitutes satisfactory work, the good work produced in the afternoon will be ex-

actly the same as that produced in the morning. The judgment which is frequently so disastrous on the part of our men employees will not enter into the work of the woman operative. She will follow instructions absolutely. Therefore, it is extremely important for the instructor to go into the minutest detail when he is outlining the character of the work.

We have found it very difficult to teach women the difference between a dull and a sharp cutting tool. But all the difficulties mentioned, as well as others, are within the possibilities of correction; and there is no inherent reason why the women of this country should not do most of the work in our machine shops, although regulations governing such work must be more carefully stated and followed than when men alone are employed.

As a rule, the best results are obtained when the supervision of work is under the direction of men, although as immediate superiors of the women other women can be used to advantage.

When a woman begins to work in the factory it is of the utmost importance to impress on her the need of great care in the handling of machinery and also to explain that we are going to coöperate with her in keeping her free from accident hazards.

Difficulty with the clothing of women engaged in shopwork has been one of the most important problems we have had to solve, since loose sleeves, thin waists, skirts and unprotected hair are not safe in a machine shop, and to meet this problem we have encouraged the use of clothing more in keeping with factory conditions.

WOMEN OPERATING LIGHT MULTI-SPINDLE DRILLS

When we originally adopted our plans there was some uncertainty as to whether we should ask our employees to wear the type of clothing shown in the accompanying photographs; and in order to settle the question once for all, the matter was submitted to the workers in a certain department for their own decision. We had had a few minor accidents due to loose sleeves, uncovered hair and loose skirts, and it was evident that in order to protect our workers it would be necessary to adopt some type of clothing which would remove that industrial risk. We arranged for a conference with our employees in the department mentioned and left to them the selection of the clothes which they should wear. We explained to them the reason we were increasing the number of women, that it was necessary to have these women to take the places of men, that we intended to employ more and more women in the future, but that we could not forgive ourselves if we permitted their employment to result in

WOMEN OPERATING LIGHT PUNCH PRESSES. THE WIRE GUARDS HAVE A SMALLER MESH THAN WHEN MEN OPERATE THE MACHINES

accidents which might ruin their usefulness in future years. The conference was a most interesting one and the results were surprising; for of those who attended, 98 per cent voted, after a half-hour's consideration, to adopt the clothes which are illustrated in the cuts that accompany this paper. Of course, we do not ask or want our factory office employees to wear clothes of this type; they are only recommended and used in the factory proper.

Machines must be somewhat more carefully safeguarded if women are to operate them than if men were doing the work. In general, safety for women who wear proper shop clothes is provided by the same safeguards as for men, except that with wire guards it is necessary to make the mesh smaller so that the hair cannot get through and to place the guards farther from the moving parts.

The segregation of operatives has been given a great deal of attention. Until the present emergency we have made an attempt to separate our women employees from our men. We do now arrange to have our women employees quit their work a few moments earlier than the men so that the women can leave the factory without confusion, but we are making no attempt to separate them from the men in the manufacturing departments. They of necessity work on adjacent machines, for when the man who operates one of a line of machines is called to military duty we cannot move that one machine from its desirable location, but we can train a woman to operate it. Where the number of women in a department is relatively small, the desirability of segregation is most evident, and if it were possible we would segregate operations; but it has not been difficult to entirely control the situation by proper supervision, and now that our men are

becoming used to women workers, the interruptions and confusion have practically disappeared.

We have found in all classes of factory operations that women are more attentive to their work than men. They are more prompt, observe factory regulations in a better manner and, in general, are neater about their work, but we have not been able to impress them with the importance of being on hand every day. Many seem to feel that it will be perfectly satisfactory to be absent occasionally, particularly if they have any household duties to finish, and for this reason we have been careful to select those women who can be entirely relieved of such responsibilities if they enter our employ. Our record of absences of women is as a rule about 20 per cent greater than it is in the case of our male employees.

I have mentioned changing occupations in the manufacturing departments. We have also carried on a most successful experiment in the employment of women in one of the estimating departments. We have always employed many women secretaries, stenographers and clerks, but until recently have not found it advisable to employ women who were graduates of women's colleges in our commercial estimating departments, there having been a sufficient number of men trained in technical colleges to fill our requirements.

The withdrawals for military service, however, have practically exhausted our supply of technical graduates, these young men being the first to take part in military activities. We found ourselves, therefore, without a sufficient force to carry on our work, and, recognizing the situation, employed a group of college women, who are taking up the work heretofore carried on by the younger technical graduates. These young women had no technical training. They are, however, well educated and we selected those who had specialized in physics, chemistry, or other work of this character when we made our appointments. Then we immediately started an elementary course of instruction. The activity and interest of this group of young women is all that could be desired. They are more anxious to learn than the young men. The majority of them are not only anxious to earn their own living, but are most anxious to do some definite work which will release additional men for military duties. It is as yet too early to make definite statements in regard to what has been accomplished, but the situation is most promising and there is no reason to believe that our experiment will be anything but successful. This change cannot be brought about in a moment, however—there must be painstaking education and at the same time patience with inexperience.

As to the future, who can predict? Will the women we train on the work of men desire to retain their positions? It would be a wise prophet who could give a true answer at this time. But it would appear from our experience with thousands of women who have worked on the lighter machine-shop and assembly operations, that these women are always looking forward to the time when they can leave their industrial occupations and take care of a home of their own, and I do not believe that there will be any different condition after the war is over. The women who are entering our employ are prompted to do so because they are trying to do their part and because they desire to assist or supplement the family income. And it is probable that the larger number will desire to drop their factory work on the day that their husbands, brothers, or fathers return and are able to do the work for them.

# PSYCHOLOGY OF ENVIRONMENT

By C. B. LORD, ST. LOUIS, MO.

PSYCHOLOGY, either accidental or predetermined, is the basis of successful management. Walter Dill Scott says, "The time has come when a man's knowledge of his business, if the larger success is to be won, must embrace a knowledge of the laws that govern the thinking and acting of those who make and sell his products as well as those who buy and consume them."

A knowledge of these laws enables us, when making rules, not to forecast with certainty, of course, but to make an inspired guess as to the effect of any cause in advance of its execution, and thus to lessen harmful experiments.

The part of this discussion assigned to me mentions environment only, but we must not forget that in this case environment has a direct bearing upon heredity, and that most of our troubles are psychological. When the wise man said that the training of a child began thirty years before its birth, he had in mind the physical wellbeing of its mother and the moral training of its father, for both of which, as employers, we are largely responsible.

As I see my duty, it is to secure maximum efficiency. This includes maximum average output, continuity of attendance and employment, a minimum of mistakes, and the anticipating of future requirements. If this entails analysis of mechanical requirements, a clean factory, and surroundings tending to cheerfulness and begetting modesty, than I am going to do all these things. If securing the desired results necessitated doing the opposite, that would I do. Therefore I want to disclaim any benevolent interest and put the matter on a practical dollars-and-cents basis. I can more readily do this, as it has been my experience that maximum of efficiency is secured by attention to the details just enumerated.

We find that contentment in woman is not induced by allowing her too great liberty of action, but rather in laying down strict rules for her guidance. When she becomes habituated to these rules, she accepts them as logical limitations and is content, provided always that they are just, equitable, and for her ultimate good.

Dissatisfaction with surroundings is a prolific cause of discontent. The same building, the same old stairs, the same rough bench and the same work contribute to this—unless the worker be sister to the ox—in mental fatigue. And as these influences are cumulative, a crisis is possible at any time, affecting maybe the individual only, perhaps the group or mass—trifles, perhaps, and yet such slight irritation has caused more murders and started more revolutions than has oppression. And so cheerfulness is an important factor.

The temperament of woman makes her acutely sensitive to color. She is influenced longer by the mourning she wears than by the loss of the departed. She also has an intuitive desire to decorate herself, and to be opposed to surroundings that satisfy the average man. This desire, carried too far, is destructive of efficiency, as is also an entire lack of it, but we can at least cater to her innate delicacy to the extent of having neatness and cleanliness. And so in harmony with this idea all machines that are operated by girls are painted with a white, oil-proof enamel, not as a fad, but to promote cheerfulness. Our floors are scrubbed, not impulsively, but regularly. Our toilets are clean, not disinfectantly, but soap-and-water clean. It would seem beneath the dignity of an executive to be responsible for clean toilets, yet it is indicative of his management.

Personally, I am tending more and more to the conclusion that the efficiency of men and women lies as much in their mental attitude as in their manual skill. I do not mean by this that contentment makes them skillful. It does not, but if they possess a certain skill, contentment enhances their productive output and lessens their liability to mistake, hence increases their efficiency.

Woman is more self-conscious, probably I should say sex conscious, than man. This is indicated by her inherent fear of men in general, and her equally inherent desire to attract man in particular. In this latter the decorative instinct comes into play and begets clothes consciousness. While it is common to both sexes, it is intensified in woman.

During investigations which I made as to the influence of wages on morality, I came to the conclusion that while there was no general connection between the two, where immorality did exist it was due to a desire, not for better education, or food, or surroundings, but for better clothes either to arouse the envy of her fellow-workers by outdressing them, or to mingle in society beyond one's means.

The point of all this is that no woman who is clothes conscious is efficient, and any woman who is either not as well dressed, or is better dressed than her neighbor, is clothes conscious. The obvious answer is uniformity of apparel, but with sufficient latitude to permit the exercise of individual taste. We have found the remedy by furnishing at cost an unfadable blue chambray. I want to emphasize the unfadable, for it is this that makes it successful, and as the waist is the most in evidence, and most abbreviated, we require a uniform waist and apron.

The success of the uniform depends upon an absolute enforcement of the rule. It is one of the peculiarities of feminine psychology that women will obey almost any rule, however disagreeable, if it is enforced impartially; but if favoritism is shown trouble immediately results. Having in mind the pleasure women take in showing their clothes, and also that they may want to go shopping on Saturday afternoon, we make it optional with our women employees whether they wear uniform waists or not on Saturday.

I mentioned as one of the features of my duties the ensuring of a future supply. Marriages in our plants average nearly two per month where both contracting parties are employees. These marriages are invariably successful because they are the result of observation, one of the other, under the most commonplace conditions, and not the result of proximity of one to the other, each in his best clothes and on his good behavior. The uniform waist is a big factor in this; it gives girls a clean-cut, neat appearance, with only the advantages nature gave them.

In some factories girls are wearing overalls, but I think it will be found that they, or the ones responsible for the decision, were rather masculine. In my estimation, this masculine tendency accounts for much of the feminist agitation of the present day; it also accounts for the increased efficiency of women, as the reasoning and point of view are more masculine. This type also lacks acute sex consciousness and looks a man straight in the eye, but unfortunately it also has the masculine moral aggressiveness, or I might say a lack of feminine retirement, and constitutes a dangerous element in the shop.

In an article which I recently wrote for *Industrial Management*, I described our method of combating this condition, and do not wish to reiterate, but I am reminded of Katherine Blackford's remark to me in this connection, that a man's passion is the dynamo that determines his ability; but of course, she did not mean that he has to violate the social code just to prove it.

According to Blackford, man may be classified by eight cardinal attributes, but for practical purposes woman may be classified as masculine, feminine, short- or long-fingered, phlegmatic or nervous, usually interchangeable terms, and sometimes blonde or brunette, for there is considerable wisdom in the maxim, "Send a blonde salesman to secure customers, a brunette to keep them."

In considering comfort and contentment we must bear in mind that fatigue may be caused by position, by improper form or height of seat, improper foot rests, or lack of them, awkward fixtures, left-handed girls on right-handed machines and other minor causes. These are all remediable troubles, but unless adjusted they cause girls to quit, and foremen to discharge them. It should not be forgotten that as the poor workman quarrels with his tools, so does the poor executive complain of the labor material at hand, and tells what he might do were it better.

I do not know whether or not the question of pay comes under the head of environment, but as much of it goes for clothes, perhaps it may be classed as such. It is a perplexing problem and one which must be settled locally, depending, as in other things, upon supply and demand. A woman is not as strong as a man, but is more dextrous; she has not the reasoning power of a man, but has a quicker mind. Where either of these attributes add to her ability, she should reap the advantage. Where piece rates are set, they should apply equally to both sexes, but when I am asked should she receive equal hourly compensation with a man, I must answer no, but she should receive as much as, or more, than a good-sized boy.

I will conclude as I began, by quoting Scott, who says, "Psychology is, in respect to certain data, merely common sense—the wisdom of experience, analyzed, codified and formulated."

## DISCUSSION

J. N. Bethel, of the Taft-Pierce Manufacturing Company, said that his company most successfully employed in their surface-grinding department, 32 women surface grinders, who at one time were making for the Lanston Monotype Machine Company the molds for casting type, which called for a high grade of workmanship. Four of the machines were operated for several months on work that called for absolute figures with an allowable error of less than 1/10,000 in.

About twelve girls work on milling machines. They are not mechanically qualified to set up their machines, but when given good rigging hands and set-up men to set up their work, plus close supervision and careful instruction, they do very well, indeed.

Thus far girls have not been employed on the screw machines, but an alternative department is being installed to teach girls how to operate screw machines, also lathes and milling machines and cylindrical grinders.

Mr. Bethel was certain that female labor would be used to a much greater extent in his plant that ever before, and he believed that with the aid of the alternative department, girls would help solve the labor difficulties.

John W. Higgins, of the Worcester Pressed Steel Company reported that his company had been exceedingly successful and pleased with their experiment in using girls on press work in the manufacture of munitions, that is, on large cartridge

becoming used to women workers, the interruptions and confusion have practically disappeared.

We have found in all classes of factory operations that women are more attentive to their work than men. They are more prompt, observe factory regulations in a better manner and, in general, are neater about their work, but we have not been able to impress them with the importance of being on hand every day. Many seem to feel that it will be perfectly satisfactory to be absent occasionally, particularly if they have any household duties to finish, and for this reason we have been careful to select those women who can be entirely relieved of such responsibilities if they enter our employ. Our record of absences of women is as a rule about 20 per cent greater than it is in the case of our male employees.

I have mentioned changing occupations in the manufacturing departments. We have also carried on a most successful experiment in the employment of women in one of the estimating departments. We have always employed many women secretaries, stenographers and clerks, but until recently have not found it advisable to employ women who were graduates of women's colleges in our commercial estimating departments, there having been a sufficient number of men trained in technical colleges to fill our requirements.

The withdrawals for military service, however, have practically exhausted our supply of technical graduates, these young men being the first to take part in military activities. We found ourselves, therefore, without a sufficient force to carry on our work, and, recognizing the situation, employed a group of college women, who are taking up the work heretofore carried on by the younger technical graduates. These young women had no technical training. They are, however, well educated and we selected those who had specialized in physics, chemistry, or other work of this character when we made our appointments. Then we immediately started an elementary course of instruction. The activity and interest of this group of young women is all that could be desired. They are more anxious to learn than the young men. The majority of them are not only anxious to earn their own living, but are most anxious to do some definite work which will release additional men for military duties. It is as yet too early to make definite statements in regard to what has been accomplished, but the situation is most promising and there is no reason to believe that our experiment will be anything but successful. This change cannot be brought about in a moment, however—there must be painstaking education and at the same time patience with inexperience.

As to the future, who can predict? Will the women we train on the work of men desire to retain their positions? It would be a wise prophet who could give a true answer at this time. But it would appear from our experience with thousands of women who have worked on the lighter machine-shop and assembly operations, that these women are always looking forward to the time when they can leave their industrial occupations and take care of a home of their own, and I do not believe that there will be any different condition after the war is over. The women who are entering our employ are prompted to do so because they are trying to do their part and because they desire to assist or supplement the family income. And it is probable that the larger number will desire to drop their factory work on the day that their husbands, brothers, or fathers return and are able to do the work for them.

# PSYCHOLOGY OF ENVIRONMENT

By C. B. LORD, ST. LOUIS, MO.

PSYCHOLOGY, either accidental or predetermined, is the basis of successful management. Walter Dill Scott says, "The time has come when a man's knowledge of his business, if the larger success is to be won, must embrace a knowledge of the laws that govern the thinking and acting of those who make and sell his products as well as those who buy and consume them."

A knowledge of these laws enables us, when making rules, not to forecast with certainty, of course, but to make an inspired guess as to the effect of any cause in advance of its execution, and thus to lessen harmful experiments.

The part of this discussion assigned to me mentions environment only, but we must not forget that in this case environment has a direct bearing upon heredity, and that most of our troubles are psychological. When the wise man said that the training of a child began thirty years before its birth, he had in mind the physical wellbeing of its mother and the moral training of its father, for both of which, as employers, we are largely responsible.

As I see my duty, it is to secure maximum efficiency. This includes maximum average output, continuity of attendance and employment, a minimum of mistakes, and the anticipating of future requirements. If this entails analysis of mechanical requirements, a clean factory, and surroundings tending to cheerfulness and begetting modesty, than I am going to do all these things. If securing the desired results necessitated doing the opposite, that would I do. Therefore I want to disclaim any benevolent interest and put the matter on a practical dollars-and-cents basis. I can more readily do this, as it has been my experience that maximum of efficiency is secured by attention to the details just enumerated.

We find that contentment in woman is not induced by allowing her too great liberty of action, but rather in laying down strict rules for her guidance. When she becomes habituated to these rules, she accepts them as logical limitations and is content, provided always that they are just, equitable, and for her ultimate good.

Dissatisfaction with surroundings is a prolific cause of discontent. The same building, the same old stairs, the same rough bench and the same work contribute to this—unless the worker be sister to the ox—in mental fatigue. And as these influences are cumulative, a crisis is possible at any time, affecting maybe the individual only, perhaps the group or mass—trifles, perhaps, and yet such slight irritation has caused more murders and started more revolutions than has oppression. And so cheerfulness is an important factor.

The temperament of woman makes her acutely sensitive to color. She is influenced longer by the mourning she wears than by the loss of the departed. She also has an intuitive desire to decorate herself, and to be opposed to surroundings that satisfy the average man. This desire, carried too far, is destructive of efficiency, as is also an entire lack of it, but we can at least cater to her innate delicacy to the extent of having neatness and cleanliness. And so in harmony with this idea all machines that are operated by girls are painted with a white, oil-proof enamel, not as a fad, but to promote cheerfulness. Our floors are scrubbed, not impulsively, but regularly. Our toilets are clean, not disinfectantly, but soap-and-water clean. It would seem beneath the dignity of an executive to be responsible for clean toilets, yet it is indicative of his management.

Personally, I am tending more and more to the conclusion that the efficiency of men and women lies as much in their mental attitude as in their manual skill. I do not mean by this that contentment makes them skillful. It does not, but if they possess a certain skill, contentment enhances their productive output and lessens their liability to mistake, hence increases their efficiency.

Woman is more self-conscious, probably I should say sex conscious, than man. This is indicated by her inherent fear of men in general, and her equally inherent desire to attract man in particular. In this latter the decorative instinct comes into play and begets clothes consciousness. While it is common to both sexes, it is intensified in woman.

During investigations which I made as to the influence of wages on morality, I came to the conclusion that while there was no general connection between the two, where immorality did exist it was due to a desire, not for better education, or food, or surroundings, but for better clothes either to arouse the envy of her fellow-workers by outdressing them, or to mingle in society beyond one's means.

The point of all this is that no woman who is clothes conscious is efficient, and any woman who is either not as well dressed, or is better dressed than her neighbor, is clothes conscious. The obvious answer is uniformity of apparel, but with sufficient latitude to permit the exercise of individual taste. We have found the remedy by furnishing at cost an unfadable blue chambray. I want to emphasize the unfadable, for it is this that makes it successful, and as the waist is the most in evidence, and most abbreviated, we require a uniform waist and apron.

The success of the uniform depends upon an absolute enforcement of the rule. It is one of the peculiarities of feminine psychology that women will obey almost any rule, however disagreeable, if it is enforced impartially; but if favoritism is shown trouble immediately results. Having in mind the pleasure women take in showing their clothes, and also that they may want to go shopping on Saturday afternoon, we make it optional with our women employees whether they wear uniform waists or not on Saturday.

I mentioned as one of the features of my duties the ensuring of a future supply. Marriages in our plants average nearly two per month where both contracting parties are employees. These marriages are invariably successful because they are the result of observation, one of the other, under the most commonplace conditions, and not the result of proximity of one to the other, each in his best clothes and on his good behavior. The uniform waist is a big factor in this; it gives girls a clean-cut, neat appearance, with only the advantages nature gave them.

In some factories girls are wearing overalls, but I think it will be found that they, or the ones responsible for the decision, were rather masculine. In my estimation, this masculine tendency accounts for much of the feminist agitation of the present day; it also accounts for the increased efficiency of women, as the reasoning and point of view are more masculine. This type also lacks acute sex consciousness and looks a man straight in the eye, but unfortunately it also has the masculine moral aggressiveness, or I might say a lack of feminine retirement, and constitutes a dangerous element in the shop.

In an article which I recently wrote for *Industrial Management*, I described our method of combating this condition, and do not wish to reiterate, but I am reminded of Katherine Blackford's remark to me in this connection, that a man's passion is the dynamo that determines his ability; but of course, she did not mean that he has to violate the social code just to prove it.

According to Blackford, man may be classified by eight cardinal attributes, but for practical purposes woman may be classified as masculine, feminine, short- or long-fingered, phlegmatic or nervous, usually interchangeable terms, and sometimes blonde or brunette, for there is considerable wisdom in the maxim, "Send a blonde salesman to secure customers, a brunette to keep them."

In considering comfort and contentment we must bear in mind that fatigue may be caused by position, by improper form or height of seat, improper foot rests, or lack of them, awkward fixtures, left-handed girls on right-handed machines and other minor causes. These are all remediable troubles, but unless adjusted they cause girls to quit, and foremen to discharge them. It should not be forgotten that as the poor workman quarrels with his tools, so does the poor executive complain of the labor material at hand, and tells what he might do were it better.

I do not know whether or not the question of pay comes under the head of environment, but as much of it goes for clothes, perhaps it may be classed as such. It is a perplexing problem and one which must be settled locally, depending, as in other things, upon supply and demand. A woman is not as strong as a man, but is more dextrous; she has not the reasoning power of a man, but has a quicker mind. Where either of these attributes add to her ability, she should reap the advantage. Where piece rates are set, they should apply equally to both sexes, but when I am asked should she receive equal hourly compensation with a man, I must answer no, but she should receive as much as, or more, than a good-sized boy.

I will conclude as I began, by quoting Scott, who says, "Psychology is, in respect to certain data, merely common sense—the wisdom of experience, analyzed, codified and formulated."

## DISCUSSION

J. N. Bethel, of the Taft-Pierce Manufacturing Company, said that his company most successfully employed in their surface-grinding department, 32 women surface grinders, who at one time were making for the Lanston Monotype Machine Company the molds for casting type, which called for a high grade of workmanship. Four of the machines were operated for several months on work that called for absolute figures with an allowable error of less than 1/10,000 in.

About twelve girls work on milling machines. They are not mechanically qualified to set up their machines, but when given good rigging hands and set-up men to set up their work, plus close supervision and careful instruction, they do very well, indeed.

Thus far girls have not been employed on the screw machines, but an alternative department is being installed to teach girls how to operate screw machines, also lathes and milling machines and cylindrical grinders.

Mr. Bethel was certain that female labor would be used to a much greater extent in his plant that ever before, and he believed that with the aid of the alternative department, girls would help solve the labor difficulties.

John W. Higgins, of the Worcester Pressed Steel Company reported that his company had been exceedingly successful and pleased with their experiment in using girls on press work in the manufacture of munitions, that is, on large cartridge

cases, helmets, etc., both on screw-machine work and press work, and especially in inspecting and gaging. They are deft, and uniformly more successful than men in these operations. Classes are being planned in the boys' trade school and girls' trade school for preliminary instruction for girls who have not worked in mills, in operations of inspection, gaging and assembling, and also to familiarize them with machine-shop methods and practice, especially with a view to their protecting themselves against accidents by teaching them the dangerous points of a machine, and also how they may conserve their strength.

Frank E. Blake, of the Remington Arms-Union Metallic Cartridge Company, stated that his plant had employed women for about forty years. In their new rifle plant, which was organized and equipped for men exclusively, and where up to a year and a half ago none but men were employed, 1300 girls and women are now very successfully employed, and very largely through the efforts of the 1300 women their output has jumped from 300 a day to 5000 a day. The women are employed in milling, drilling, polishing, filing, inspecting, and all of the operations in the shop which do not require man's strength.

A uniform has been adopted consisting of an apron and a net cap, which provides the ventilation that a closer woven cap would not give, and an apron of an approved design.

The speaker felt that the girls in the shops would stay there whether the war stayed or not. They have a place there, they are doing good work, and work that is satisfactory to the management. In one shop upward of 5000, and in the other about 1300, are employed.

L. W. Wallace, of the Diamond Chain Company, pointed out that the employment of women in the Diamond Chain Manufacturing Company was no experiment, as it had been done for 25 or 30 years. At the present time 30 per cent, or 300, of the factory force is composed of women. They are used successfully on punch presses, light and heavy assembling machines, automatic machinery of all sorts, drill presses, where they operate a gang of eight drills, and countersinkers, and on assorting, gage-inspection and assembly work. Women in the engineering office are doing drafting work. Two university graduates are in charge of the bonus department and cost department.

There is a woman called "Director of Mutual Service" who looks after the welfare of the women, their wage increases, their discipline, their discharges, their disputes. Through her the whole plane of the factory has been raised. Men and women work together, they check out on the same clock, get their pay from the same window, wash up in the same place. Profanity and obscene stories are absolutely barred, and because of that college graduates and high-school graduates are coming in and the general plane of the factory is being very much raised, and thus there is no trouble in attracting to the factory a high type of young womanhood.

Mrs. Harry E. Heustis, superintendent of women in the Ross Rifle Works, Canada, explained how the women of Canada volunteered as did the English women, and as the American women are doing, as munition workers, supplementing men for war service. They went in as machine operators, on drills and on all the other machines. There are three women experts in rifling. They set their own machines, grind their own cutters, and give an output in quality and quantity as high as any expert man rifler.

Miss Kate Gleason, Mem.Am.Soc.M.E., emphasized the fact that now the best class of women are attracted to the work in the skilled industries. In years past they were used on automatic machinery, which deadened their minds. Miss Gleason cited the case of a woman in Berlin, employed at the Deutschen Waffen Fabrik, who had been one of the many ordinary women employed there, but when the man at the head of her department had to go to war, she was given his place, and now is full of the pride and power of a real job.

Another woman in Rochester, forelady of a shoe factory, invented team work in shoe manufacturing. Through it her employer made a great fortune and it cut the price of shoes in two.

Major Frank B. Gilbreth brought up the question of the elimination of unnecessary fatigue.

This question of unnecessary fatigue in the industry is not to be confused with necessary fatigue. We expect workers to go home fatigued when night comes, we will insist on their having enough work to be fatigued when night comes. The proposition to be discussed is unnecessary fatigue. A fatigue survey should be made in each plant. A fatigue survey will bring out the fact, for example, that women use the wrong kind of chairs. Nearly all women insist on trying on their shoes before they wear them, but many in this country, certainly not one per cent, have had chairs assigned to them, with their names or numbers on them, and yet the necessity for that is perfectly obvious. The idea of assorting people by the top of the head from the floor, when it is the elbow that determines their length from a sitting or standing position, is ridiculous.

Major Gilbreth agreed with Professor Kimball, who, in speaking at the luncheon on Thursday, stated that mechanical engineering consists of almost everything in the world. He further continued, "I also agree with him on the psychology of management, and yet how little we act, from a psychological standpoint, having the employees and employers get in the habit of meeting on some subject, coming together during the period of lockouts and strikes, and if they would take this subject of the elimination of unnecessary fatigue as one typical case that they have no scrap about, and get in the habit of agreeing, it would be of great benefit."

A. W. Marshall related an experience with two damage cases against employers on behalf of girls who had had their scalps torn off on account of working near moving machinery. Such accidents can be very serious, and in both these cases the girls had their entire scalps cut off, and they were mutilated for life. Therefore it is of extreme importance that the women's hair be protected, either by caps, or by having the machinery amply protected. Both of these injuries were due to the fact that the shafts on which the hair was caught were charged with frictional electricity, which attracted the hair to them.

E. J. Poole took up several questions concerning the employment of women in the steel industry. First, in the matter of lifting, it was found that up to a certain point women were just as efficient as men. He told of an amusing incident of a man who was an employee in a wire mill who was continually complaining about having to lift the heavy coils of wire. One night his wife brought his supper to the mill and said to him, "Where are those heavy coils you have been complaining that you have to lift?" He pointed to them. They weighed probably from 40 to 70 pounds. She was rather husky and with

one hand picked up a coil and threw it on the reel. Immediately everybody began to chaff him and we have never heard any complaint from him or from any other man doing that same class of work.

As to the question of mixing nationalities, this should be done in order to avoid trouble.

On the question of wages, the system that has been very successful in England has been followed, namely, two-thirds of the wages of the men who are on that particular job. When the women become proficient they get the full wages of the men. If it is piece work they get the same piece-work rate that a man gets.

On the question of close work, in grinding for example, women do a great deal better work than men formerly employed.

Professor G. F. Blessing spoke of the research work done in Swarthmore College. Swarthmore College is a coeducational college, and it seems that the ideal we are striving for is to fit men and women for the same industry.

Professor Blessing described how fatigue-elimination day was observed at Swarthmore.

"We had our juniors in drawing and kinematics design fatigue-eliminating devices that might apply to their own work. For example, they would design a student lap board—that placed everything in a convenient and unique position. Another designed what he called a desk combination or help, on which he arranged all the things that he used in his ordinary studies in the most convenient place possible, and from that we worked along. In the shop we built a couple of Mr. Gilbreth's chairs, and we wrote to a number of the business and manufacturing men in Philadelphia to send us out such devices as calculating machines to be exhibited, and so we kept open house in the engineering laboratory during that day, and had all the students go through. In my class I had them write a report on conditions that they found wrong in the college."

Prof. F. R. Hutton, the chairman of the meeting, recalled the visit of the society to the Cash Register Company of Dayton, Ohio. The very best quality of women workers were secured by the simple means of allowing the women to leave the plant at five minutes of five so that they might have the advantage of going back in a trolley car from the cash register works into town a little ahead of the rush.

The following companies outlined their practical experience in the employment of women in the skilled industries on the questionnaires sent them: E. W. Bliss Company, Mergenthaler Linotype Company, Worcester Pressed Steel Company, American Locomotive Works, Brown & Sharpe Manufacturing Company, Hamilton Gear and Machine Company, Canada, P. W. Ellis Company, Limited, Canada, Canadian Fairbanks-Morse Company, Limited.

The Engineer, the Cripple and the New Education, by Major Frank B. and Lillian M. Gilbreth, was the next feature of the session. The paper is given here practically in full.

## THE ENGINEER, THE CRIPPLE AND THE NEW EDUCATION

BY FRANK B. GILBRETH AND L. M. GILBRETH, PROVIDENCE, R. I.

THE purpose of this paper is to report progress in the solution of the problem of training the crippled soldier. At the present stage of the work we are able to formulate certain conclusions that have a bearing upon the activities of this Society and upon the part that the Engineer should take in the Crippled Soldier work.

These conclusions are as follows:

*a* The Crippled Soldier problem is practically identical to the problem of the cripple in general

*b* Its solution lies in a new type of education

*c* This education is destined to be the education of the future

*d* It is based on

(1) Finding the *one best way to do work*

(2) Adequate assignment to work, i.e., intensive vocational guidance

*e* The engineer is best fitted to determine the one best way to formulate it into methods, and to supply necessary devices and mechanical appliances.

All cripples, no matter what the cause of the crippling, require a training that will be mentally satisfying and physically beneficial. This training must be such as will enable them to become productive members of the community, and to remain on the world's payroll. This implies either competing with non-crippled workers in occupations open to all, or setting aside certain work for crippled workers exclusively, or both. It implies discovering and making available such opportunities for crippled workers, discovering which cripple is best fitted to utilize the opportunity, and training him to make the best possible use of it. It also implies not only opportunities for individual development, but such social opportunities as will enable the cripple to fit back into the ordinary social life with the greatest ease and the largest amount of durable satisfaction.

Those crippled in war furnish a small percentage of the total crippled as compared with those crippled from other causes, such as disease and accidents, especially in the industries. This is true even in Canada, which has furnished such a remarkable quota of fighting men in comparison with the total number of her population.

The solution of the crippled-soldier problem as outlined above consists of a type of education that is *new* in that it eliminates the greatest amount of waste possible in the educational process. It teaches *the one best way* at the outset, instead of following the old practice of "learn every way," with the vague hope of arriving at efficiency as an outcome. It enables the learner to arrive at a desired outcome with the greatest amount of speed and the least amount of effort, and with the largest return in efficiency and the resulting satisfaction.

This new method of education, discovered as a result of synthesizing measurements of champion workers in our *quest of the one best way to do work*, is spreading through the general interest in re-educating military cripples to the re-education of all cripples into the manual-training schools, corporation schools and the general educational fields.

### TWO PHASES OF THE NEW EDUCATION

The new education has two parts: first, discovering the one best way to do work, and second, testing the individual and placing him at the demonstrated most appropriate work. By "work" we mean activity of any kind, whether physical or mental, for the investigations and the resulting methods are being made and applied in mental as well as physical fields of activity, as a result of our findings based on micromotion and cyclegraph records, which prove that the laws of habit formation apply equally well to mental and motion work.

The engineer is the natural person to whom the world now looks to find *the one best way*. This one best way is based

on accurate measurement—not guesswork, personal opinion, bias, or the vote of a majority of a committee who have not measured. The engineer's training in measurement fits him specially for doing the requisite work.

### No Limit to Cripple Problem

To recapitulate, the *extent* of the cripple problem is, then, practically unlimited. When we come to consider the subject closely, we see that every one of us is in some degree a cripple, either through being actually maimed or through having some power or faculty which has not been developed or used to its fullest extent. The degree of crippling extends from the worker, who, through some accident, has lost his eyesight, his hearing, and the use of his legs, arms and hands except for the use of one finger—and, by the way, this is no imaginary illustration, as we have lately received a skilfully woven bag made by such a cripple maimed through a mining accident—to a man who is dependent upon glasses for reading. We can think of every member of the community as having been a cripple, as being a cripple, or as a potential cripple. Conversely, we can think of a badly mutilated man as not being a cripple during the period that he is at that work *the performance of which is not affected by the mutilation.*

As to the *nature* of the problem of the cripple, it is a problem of education, as has been said. *With the present state of the art of teaching, it is largely a problem of re-education,* since most of us, non-crippled as well as crippled, have received the wrong type of education, and must be re-educated even in the fundamentals. As education becomes more scientific, the problems of re-education will become simplified, and the process will become shortened.

### Engineers Are Natural Solvers of This Problem

As to the natural solvers of the problem of the crippled soldier, these are, as before stated, the engineers, but only if the engineers will bring to the task the scientific attitude. As a profession, we have been too apt to be satisfied with half-way methods and half-way devices. We boast of the advance in engineering science, especially of the advances in the science of management, which have to date been, with few exceptions, the work of engineers, yet general knowledge and use of instruments of precision, even when such are available, are lamentably lacking. As a specific example of this, we may cite the use of the stop watch by experienced and earnest investigators in the field of time study. If the engineer, knowing as he must that it is an insurmountable barrier to obtaining *the best method*, or even knowledge of times that are transferable to others, is to discover *the one best way to do work*, he must use the best methods and instruments extant, and he must apply these with unremitting accuracy, persistence and patience. *The one best way* consists of elements of motions accurately timed and recorded, and synthesized into the best available method of activity.

If the engineers are, as a profession, ever to take the place that they should take in this work, they must start *now* to coöperate with those working in other phases of the subject. The various aspects of the problem are being assigned to those best able to handle them. For example, the task of making surveys as to what should be and is being done, and of the opportunities open to cripples, can well be undertaken by cities, towns and other civic organizations. This is being done, notably in Chicago, where we are assisting in the excellent work now under way under the leadership of Mr. Pike, Mr. Petterson, and others. The matter of furnishing money for the investigations and for the work itself is being excellently attended to by the Red Cross, as, for example, through the Red Cross Institute, New York City, with which we are coöperating, which has sent Dr. Edward Devine abroad for personal investigation and service in the field. There is also the work of Mr. McMurtrie, Acting Director of this Institute, who is collecting a bibliography on the subject of cripples. The matter of investigating the extent of the crippling and of providing the surgical and medical attention necessary is being admirably handled under the able leadership of the Surgeon-General and other Government representatives, already famous in the medical and surgical profession, in Washington. Too much credit cannot be given to Dr. Franklin Martin and Surgeon-General Gorgas for the progress that they have made in this great work in the short time since the day after the declaration of war, when they individually honored one of the writers by giving him an interview for the purpose of outlining possible work along these lines, since which time he has been honored by being appointed on Dr. Martin's committee reporting to the Council of Defense, and is now also coöperating with Colonel Owen and other famous doctors in the Surgeon-General's department.

The psychologists have appointed committees to investigate all branches of the subject that come within their field. The psychotherapists are working on their aspect of the problem, and Mr. George Edward Barton, of the Consolation House at Clifton Springs, Past-President of the National Society for the Promotion of Occupational Therapy, has spent years in theoretical and practical work concerning the convalescence period, and is contributing his experience and energies toward helping this cause. Educators are considering not only the training of the necessary teachers, but the training of the cripples themselves, notably Prof. Frank E. Sanborn of Ohio State University, and Prof. Wm. S. Ayars of Nova Scotia Technical College—the latter an American engaged for years in teaching in Canada—both of whom are members of this Society.

### A Government Bureau Will Come

A Government bureau for collecting and conserving all these data will come naturally as a development of the activity in other fields, and of the present activity of various Government departments along various lines. This bureau should contain a museum that would include among its exhibits models of artificial limbs and appliances for cripples. This, supplemented by state and municipal museums along similar lines, would bring first-hand knowledge to the cripple, who too often buys the first artificial limb that he sees, and usually averages three or four purchases before he gets the one best suited to him.

Such a national museum should also contain fatigue-eliminating devices which would enable all workers to become more productive with less accompanying fatigue. The writers first called the attention of this Society to this need in 1910, feeling that fatigue study, like accident prevention, is a function of the engineer. We have, since 1913, started several small museums of devices for eliminating unnecessary fatigue, hoping that the movement would spread, and in the winter of 1915 tried to get the National Museum at Washington to start such a department, but apparently were not able to arouse much interest, though we were asked and thanked for a collection of wire models of motions. Recently Colonel Owen became interested, and now a definite start has been made.

The great need for fatigue elimination for the crippled soldier will undoubtedly lead to interest in the subject in this country as it has in England, for until recently we have had much more encouragement in our campaign for fatigue study from Englishmen than from our own countrymen. Mr. James F. Butterworth, ever ready to disseminate information relating to managerial economies, was the first to bring the matter to the attention of the British public. Prof. A. F. Stanley Kent incorporated his investigations of fatigue of munitions workers in reports, written by order of the King, since reprinted by this Government and obtainable at Washington. Prof. Henry J. Spooner wrote a series of articles on Industrial Fatigue in its Relation to Maximum Output for *Co-Partnership* (London), since issued as a booklet, which should be in the hands of every engineer and employer, and should also be reprinted by our Government and put on sale by the Superintendent of Documents.

The data for such reports and articles come from investigations of present conditions and realization of their significance. If the present chairs and work benches now to be found in all parts of this country, as well as abroad, were collected and put beside such efficient devices as the Barney chair and foot rest, and the Marshall traveling chair, they would look as out of place and cruel as do the devices of torture of the medieval period. Observing this, and with the cripple in mind, it will be noted that the principles underlying the adapting of chairs and foot rests to the industrial worker's measurements and to the needs of the cripple are identical.

### Cripples Eager to Cooperate

This profession as a whole has not given the full benefits of its education, training and ingenuity to the industrial cripples of the past. The more we investigate the problem of the cripple, the more we marvel at their patience and the fortitude with which their calamities have been met and endured. They have made so few demands. They have been so pitifully eager to cooperate in this new work. They are, throughout the entire country, for the first time seeing the opportunity to do constructive work for their fellows, not only by showing what the maimed and handicapped can do, but by acting as examples of cheerfulness and continuity of purpose for all to follow. They are seizing this chance to do their bit for the war and for their country, and have shown such intelligent cooperation that we are led to agree with Mr. Fred J. Miller, Past Vice-President of this Society, that a man who has lost a limb becomes thereafter more active both physically and mentally.

Now the needs of our industrial cripples are supplemented by the more pressing need of the crippled soldiers. The crippled soldier is at a disadvantage, as compared with the industrial cripple, in that he is often at a distance from aid of various kinds at the time that the crippling takes place, and thus misses the chance for the early re-education that is desirable and necessary. Second, in that through mistaken kindness he is not taught work of any kind during his convalescence and during the period immediately after his return home; in fact, he is often encouraged by misguided friends to remain idle until the possibility of teaching the maimed member and the mind that has stopped learning, has decreased, and re-education becomes more difficult, if not actually impossible. Third, through the terrible physical and mental anguish that often precedes, as well as follows, the crippling.

The crippled soldier has the advantage over the industrial cripple in that he is the object of great interest and patriotic sympathy, therefore is a member of the community to be courted rather than shunned; in that he suffers in the limelight, and therefore is practically assured of assistance as soon as the world is convinced as to what he needs; in that he will have, if he has not now, expert training at his disposal; in that he has the consolation of fame and of having done something worth while, even though he had to pay the penalty of being crippled for having done it.

### The Engineer and the Crippled Soldier

For these reasons it is advisable that the engineer turn his attention immediately to the problem of the crippled soldier, supplying the new education in the form of re-education for this soldier, with the assurance that when the methods and devices have been supplied, the industrial and other cripples will benefit exactly as will the crippled soldier.

We have already brought out, in papers on progress in crippled-soldier work, the various needs that must be met. One is the need of adapting methods and devices to the cripple, and another the need of adapting the cripple to existing methods and devices. The engineer has a part in meeting both these needs, that is,

*a* In inventing or adapting detached devices that will make it possible for cripples to do various kinds of work, such as various devices furnished us by the makers of the Remington, Monarch and Smith Premier typewriters, that enabled a one-eyed, legless, one-armed and one-fingered typist to write many more short letters in a given time than can the unmaimed champion typist of the world;

*b* In providing artificial limbs to replace those missing. Particular attention is called to the possibilities of inventing countless designs of articulated limbs controlled by systematized use of the trunk muscles controlling the joints of the limbs by means of wire and springs for replacing other muscles and tendons;

*c* In inventing or adapting devices that may be attached to the cripple himself, not to replace missing limbs, but in effect to supply new ones, i.e., additional limbs that will enable him to use existing equipment and thus accomplish work.

### Use of Supplementary Limbs

Artificial limbs may therefore be supplemented or supplanted by what we have called "supplementary limbs," for examples, (1) a ring or loop attached to the suspenders or belt for assisting a one-armed man to handle a shovel, as suggested and used practically by Dean Cullamore of Delaware University; (2) yokes, special belts and grasping devices operated by pressure of the body against the work bench; (3) "the third thumb" for holding a magnifying glass.

Undoubtedly for all-around and general purposes it would seem to many people presumptuous to attempt to improve much upon nature in the question of the design of the human being. There is a resemblance here to our educational systems. Our educational systems are extremely good in many cases for all-around purposes, but they can be easily improved upon by any one who knows exactly what is needed for a special case. We therefore urge all who undertake this work of specially fitting the cripple to perform an activity not to hesitate to "improve on nature" at any time. This new viewpoint will help to handle many difficult cases. We hope soon to present a paper showing in detail practice of putting an extra number of limbs at the disposal of the unmaimed worker, a development of this work for cripples.

SIMULTANEOUS CYCLE MOTION CHART

We have been much assisted in adapting both devices and cripples by the use of our Simultaneous Cycle Motion Chart.[1] Through the elements there listed, such as "search," "find," "select," "grasp" and "transport," we have been enabled to invent or suggest, in highly repetitive work, some contrivances that are creating a new era in efficiency, as can be easily realized when the comparative simultaneous cycle motion charts before and after the investigation are studied. It is but necessary to call attention to the facts that all "grasping" is not done by the hand; that "positioning" may even be a function of the mouth; that the ordinary workman's apron with its many pockets may be used to relieve working members of the body, and that "inspection" for quantity and quality is by no means always a function of the eyes. There is an opportunity in "the device to handle the device" that will satisfy the yearnings of the most ambitious mechanical and inventive mind, a field almost without end that will eventually make the new era in industry date from the sacrifices of this war.

[Major Gilbreth here showed some pictures of methods and devices already in use, valuable as suggestions of what can be done along these lines.]

## DISCUSSION

The paper called forth discussions so wide and varied that one speaker suggested that the objects of The American Society of Mechanical Engineers might well be redefined so as "to include every subject in the world." At least, the subject was taken up from many different angles and held the interest of a large audience throughout.

Col. W. O. Owen wrote that Major Gilbreth had struck the true note when he referred to the new education. It will be used not only for the training of the cripple, but for the training of the more active man. He will be taught to do his work in a better and more economical way, so that the fatigue of labor will be materially lessened. He approved of the suggestion that the motions of individual men who do their work better than their neighbors should be analyzed with respect to time, distance and motion, and said that if the best parts of these motions should be combined into a new motion the apprentice who learns this new motion will be able to do the work in shorter time and with less fatigue than those whose motions he has combined. He agreed with the author that the one best way seldom, if ever, exists in the consecutive-motion, cycle units of any one individual.

In speaking of the relation between the medical man and the engineer Colonel Owen wrote: "I believe that there is but one difference between individuals which makes one prefer to be an engineer and the other to be a medical man. It is purely a matter of receiving suggestions one on top of the other until an individual finally drifts into one or the other profession.

"I do not agree with Major Gilbreth that the engineer is best fitted to determine the 'one best way' or to formulate it into methods. I cannot help but feel that the medical man is the best fitted for these purposes. The engineer tried his hand, and a most expert hand it was, at Panama, some years ago, and failed, and I rather suspect that the engineer would have failed this time at Panama had it not been for a medical man coming to his assistance."

George Edward Barton[2] wrote that while the author's paper presents ideas that were new to many, the subject had occupied his entire attention at Consolation House for several years. In his work he was endeavoring so to combine the engineer and the cripple by re-education that, by making a virtue of necessity, the cripple was assisted to health and remunerative labor. This inevitably became a part of the work of the engineer and not of the doctor—or even of the orthopedist—for it was essentially treatment not by "physic" but by "physics."

To illustrate, he considered the case of a man who, as a result of shock, had what might be vulgarly called "a spasmodic sidewise jerk" of his arm, a case which he would analyze as follows:

"What have we got?"

"Well," says the doctor, "we have an hysterical condition of incoördination."

"D——n," say I. "That's a liability. What have we for an asset?"

"Nothing," says the doctor.

"But let us examine. What is it? What is this 'spasmodic sidewise jerk'?"

"Analysis shows that at least we have motion. Well, motion is of value throughout the entire industrial world, is it not?"

"What kind of motion have we got?"

"An irregular, intermittent, horizontal motion."

"Very good. Now, how can such a motion be used to the therapeutic advantage of the patient, resulting in some useful product? Or, if that motion cannot be so used, how can it be transformed into some other motion which can be so used?"

Mr. Barton continued: "All of us in the engineering world know that the problems of the engineer are essentially human problems; but those in the world who are not engineers regard his heart as being as hard and cold as that of the stone and metal with which he works."

W. S. Ayars wrote that the fact must not be overlooked in the problem of re-education that the raw material to be worked with is human. The task is not to select and train men for certain jobs so much as to select jobs for certain men, and then to train the man and modify the job so as to make them fit mutually. In the scientific selection and employment of men, it is admitted that one of the strongest points in favor of assigning a man to his job is the man's *appetite for the job*. It is all very well to make an expert typist out of a legless one-armed man who has a natural bent toward clerical work, but suppose he happens to have been an electrical lineman before enlisting, and had then lost two legs, or even one? Many such men have had their minds bent toward electrical work in general, and are agreeably surprised when they learn that there are plenty of branches of electrical work where the worker can sit at a bench and earn as good or better wages than they ever earned climbing poles and splicing wires.

Professor Ayars went on to describe the re-education work that is being done in Nova Scotia when the men return from Europe. First, in the convalescent hospitals, classes were organized in such work as boot and shoe repairing, automobile repairing and driving, novelty and jewelry work, etc., in addition to English branches and practical mathematics. This sort of work is vocational training.

What we call re-education is the intensive training given to men whose wounds or disabilities are such that they can no longer earn a living at the occupations they had before enlisting. Any man who is so disabled that he is entitled to discharge and pension, may come before a board consisting of at least one regular army officer, one medical officer, and a properly qualified civilian, and be passed for re-education,

[1] See Applied Motion Study, Sturgis & Walton Co., New York.

[2] Director, Consolation House (Vocational school for convalescents), Clifton Springs, N. Y.

should he so desire; and every effort is made to induce the man to do so. He must then decide what line of work he wishes to take up. He is given all the advice and help and encouragement possible, and is frequently persuaded, but never *forced*, to attack some lines of work that he had never thought of before. When he has made his choice, he can get his discharge and his pension, and in addition will receive pay and allowances as long as he is engaged in his re-education.

The Nova Scotia Technical College contemplates the following courses: drafting, garage or automobile mechanics, machine-tool operation, electrical wireman, steam-engine operation. These are intended for men of good common-school education, and others who can get enough of elementary mathematics in the vocational training classes before taking up re-education.

Then for men of mechanical taste, but not enough elementary education for any of the above courses, there is a course in boot and shoe making. This course will not turn out "cobblers" but real "mechanics in leather," and the progress made by some of the men is remarkable. In addition to all the usual hand and bench tools, there is a fine equipment furnished by the United Shoe Machinery Company, and the men are taught to build a shoe from the bottom up. As fast as they become skilful enough, they are given regular work and paid for it, the pay going into a fund to pay for a complete "kit," so that upon completing the course the graduate has a full outfit wherewith to set up on his own account.

Men who desire to take up certain other courses are accommodated by placing them in existing schools or commercial establishments where they can learn what they require. A course in janitor work is now being worked out for such men, covering the care and operation of boilers and heating systems, a little elementary arithmetic and English, and the simple knowledge of repairs to wiring, steam pipes and plumbing that a good janitor should possess.

One of the many difficulties encountered in this work is the fact that the men cannot be handled in anything like groups or classes. The work is practically tutorial: each man is a unit. They are assigned to the instructor each one in turn as he is passed by the board; they are of all "sizes," mentally speaking: what is hard for one man is easy for another.

Thus in the face of such conditions, how are we going to stop and apply Mr. Gilbreth's tests and studies? And where are we to get the men and the money to perform these tests? And how do we know that after A has been studied and tested for six months, and satisfactorily started on his course, that the data gained by such a test will have the slightest bearing on B, with a similar injury?

One point to be considered is the necessity for getting these men started *promptly*. Here again we encounter the difficulty of applying Gilbreth's personal studies and tests. Where shall we ever find the number of properly qualified motion-study experts to handle not dozens but thousands of cases?

It might be argued that a few specimen cases could be intensively motion-studied, and the data applied to all similar cases. It is conceded that motion study offers the best method of finding the standard way for a standard man to do any given piece of work, skilled or unskilled. But when the number of different possible injuries is considered; and the number of different possible personalities; and the number of different possible trades, jobs, or subdivisions thereof, then the number of permutations and combinations would startle the most hardened mathematician that ever lived, and the job of properly fitting the men to the jobs would require a small army of highly paid experts.

The work with the crippled soldier is very inspiring and congenial. The men are alert, cheerful and responsive; absolutely square and honest in their work, and with the unconscious courtesy and respectfulness bred into them by military discipline. They are likewise scrupulously neat and clean, always clean shaved, with clothing, buttons and boots in spotless order; all but two or three still wear their uniforms, and even those who have donned civilian garb have retained the little gold "wound stripe" on the sleeve, and always wear the little copper button of the returned soldier. A great many of them, to paraphrase from one of Gilbreth's other papers, will bless the day they were wounded, for already we have placed men who have finished their courses in far better paid jobs than they held before enlisting, or would have held at present had they never enlisted.

Prof. Frank E. Sanborn[1] was of the opinion that the work with the crippled soldier should be begun while they are still in the hospital, and as early as their nervous conditions will allow. The men have all left some occupation to take temporarily that of the soldier. As they lie in the hospitals and think of their wounds, they cannot but wonder how they are going to get on in the future, what they will be able to do for a livelihood. The outlook is decidedly blue.

There is nothing better to inspire these men, to cheer them up and to set their thoughts in a constructive channel, than to have brought to their attention those things which other cripples have done. These things can be illustrated by moving pictures and explained by talks. Information should be given about schools for their re-education for some occupation. These pictures need not necessarily be the one best way to do the work, but they will serve their purpose if they make the cripples hopeful and implant the thought that what one cripple has done another may do. When the men are able to begin their re-education along the lines of either their old work or a new occupation, what is more natural than to teach them the very best way of doing the work, a best way that is not entirely dependent upon someone's whim or say but a way that can be shown to be the best by means of measurements, scientifically obtained—measurements of motion, time, quality and quantity of output and fatigue.

In learning a way of doing work, the cripple or the whole man usually follows the motions of his instructor. These may be made so quickly that the learner can neither catch them nor visualize them. Until he can do so, he will make no progress. It is not enough or even right that the instructor go through the motions slowly, for slow motions are not in the same path as quick ones and a learner should learn the quick ones at the start. Therefore, pictures of the path desired are helpful and still more so are the wire models of the paths and the speed.

The Government is planning for reconstruction hospitals in this country and for re-education centers connected therewith. It is hoped that it will follow out the suggestions of the author and find the one best way for each part of an occupation and the one best way for the different classes of cripples, and have that way taught in the centers.

A. L. Curado[2] wrote of the willow furniture industry as affording a remunerative occupation for the cripple. It is an occupation in which a man sits while at work on a bench similar to a cobbler's bench. There is no machinery, the tools are few, the work is not too heavy and is very healthy. There

[1] Ohio State University.
[2] Manager, Massachusetts Commission for the Blind, Broom and Willow Shop, Cambridge, Mass.

is a very great opportunity for creative work in this line of industry, as the uses to which willow may be put are innumerable.

In picking out an industry for a cripple, the willow furniture industry as well as any other, four fundamental factors must always be considered: (1) Can this work be done by a cripple? (2) Is there an economic value to the work? (3) Can the cripple compete with a non-cripple in the work? and (4) What about teachers?

Horace B. Drury[1] commended Major Gilbreth's power of seeing very vividly possibilities of which the world at large is hardly aware. He has given a tremendous stimulus to thought along the line of motion study. In its relation to the re-education problem a field has been opened in which, fortunately, there is no set order but in which it is possible and necessary to reconstruct rapidly and freely. There are a thousand different ways in which men are crippled and a thousand complexities of occupation to which they may or may not be fitted. There is no other way of approaching this problem except by charting and measuring, by gathering all sorts of data and by making the most careful study, all of which offers, besides, a great opportunity and need for comprehending the psychological and physiological basis.

Dr. W. R. Dunton, Jr.,[2] was greatly impressed by the author's desire to educate the industrial cripple, as the society of which he is president is at present perfecting an organization of individuals and social agencies to assist the industrial cripple in finding his proper niche.

Dr. Dunton went on to say: "If we could refer to a National Museum such as Mr. Gilbreth describes for labor saving, fatigue eliminating and prosthetic appliances, we would be spared much of the effort which we are now expending. In a recent inquiry concerning prosthetic appliances we were amazed to find how very difficult it is to obtain information. Here alone is a subject in which the engineer should cooperate with the surgeon. The latter's knowledge of mechanics, or even physics, is usually not so extensive that an engineer cannot give him much aid. On the other hand, the specialist in nervous and mental diseases can best appreciate that any effort which tends to eliminate fatigue from our daily lives tends also to decrease the waste of human energy, diminish the number of dependents, and generally improve economic conditions.

"Part-time workers would help to solve many of these questions. A convalescent from pneumonia, a heart case, or a neurasthenic is undoubtedly a cripple in the sense used by Major Gilbreth. Many such cases may be capable of a half day's work or a half hour's work four or five times a day. Two such men could make one day on a machine, so that the latter would not be idle."

Dr. H. E. Holsey[3] thought that from a psychological viewpoint the phrase "disabled soldier" would be preferable to "crippled soldier," as the latter implies entire loss of function whereas the former suggests the loss of certain parts that function but are not of necessity incapacitated or incompetent. Otherwise the author has combined his philosophy and his psychology admirably. He has understood the importance of satisfying the mental as well as the physical benefit. "It is one of the greatest satisfactions to the human that he can feel, though disabled, that there are ways by which he can remain on the pay roll of the world.

"To achieve extraordinary results, to cultivate efficient habit forming is the important part in re-education. To measure and guide the habit and give it character is the problem presented by the disabled human." Intensive education by means of micromotion produces such results. It is rapid and understandable and at the same time can be applied to the able as well as to the disabled.

Willard E. Hotchkiss[1] pointed out that too much emphasis could not be placed on the necessity of analyzing problems and finding out how to proceed before attempting to solve them. The Gilbreths' work in substituting photography and psychology for the stop watch and their development of motion study with the finer instruments and with the more intensive methods of analysis were cases in point.

Professor Hotchkiss felt that the phrase "the one best way" should have both a time and a subject-matter limitation, for the reason that the method which appears to be the "one best way" of doing a thing today may not appear so tomorrow, as a new invention in a field apparently quite remote from the one in which a particular process has been developed may entirely change the relevancy and effectiveness of that process.

Edward Cassidy,[2] who became blind some years ago, wrote that he has been able, nevertheless, to transfer some of his technical knowledge and experience to the blind in Massachusetts and from his connections with them he realizes the ever-growing need of the knowledge of the active-sighted man or woman. These people can be of help in securing for the blind a great many positions in manufacturing plants which they could fill successfully if it were not for the fact that the employers' liability act prohibits them from obtaining positions such as packing shoes in boxes, packing candy in boxes, pasting on labels, private switchboard operators, taking messages by telephone, timekeepers, even stenographers taking shorthand minutes of meetings—positions that blind people are amply able to fill. Mr. Cassidy is of the opinion that the time is not far distant, due to the ever-increasing blindness among our people, when business men will be forced to recognize the capabilities of blind persons and to secure for them self-supporting work.

Dr. F. L. Marshall[3] wrote he had discussed with the author the possibility of employing cripples in prophylactic dentistry and was led to believe from his experience in helping demonstrate that it was possible for a cripple with one eye, one arm and no legs to thoroughly clean a patient's teeth, and that this field would be adapted for the crippled. The manual dexterity and knowledge required for this class of work would not be difficult to acquire, and in a few months' time a man of ordinary intelligence should be in a way to become self-supporting.

Professor J. B. Miner called attention to the fact that Major Gilbreth's paper and his basic contribution to motion study suggested three ways in which the science of human behavior comes in touch with this important movement. The oldest of

[1] Ohio State University, Columbus, Ohio.
[2] President, Maryland Society for the Promotion of Occupational Therapy, Baltimore, Maryland.
[3] Phoenix Bldg., Springfield, Mass.

[1] Professor, University of Minnesota.
[2] Blind Welfare Union, Inc., Boston, Mass.
[3] 39 Fairfield Street, Boston, Mass.

these points of contact between psychology and the better adjustment of man to his work, is in the study of fatigue. The mass of accumulated data has recently been illuminated by Thorndike's experimental demonstration of the difference between the feeling of weariness and the decrease in output due to exhaustion which is only corrected by rest.

The second broad field, which is perhaps more worked by the psychologist than by any other scientist, is the study of the learning process. Dr. Thurstone has recently developed an equation for the learning process which promises to enable us to foretell an individual's limit of ability early in the practice curve.

The third point of contact is in the selection of men for particular jobs. Methods for selecting salesman, which have been worked out by the Bureau of Salesmanship Research at the Carnegie Institute of Technology have proved to be not perfect, but enough better than those previously used to cause them to be adapted to the purpose of selecting officers for the national army.

The reliabilitation of cripples will become a lasting contribution to all workmen. Groups of cripples afford a rare opportunity for experiments under controlled conditions which are so difficult to provide in normal industrial life. The importance of this strategic chance to study selection and learning problems under standardized conditions has been emphasized at present by the opening at Carnegie Institute of about the first school for training wireless operators for the army, as distinct from service in the navy or in the aviation corps. Thus far about 200 of the applicants for the school have each been tested for an hour by a carefully arranged series of mental and motor tests. In helping to improve the selection and training of wireless operators, there will be an opening for certain types of cripples which should place them in line for skilled work after the war.

John Younger dwelt upon Major Gilbreth's proposition that virtually we are all cripples, or conversely, there are no cripples. He went on to say: "It is an interesting philosophy to carry this out, and reason that man at present has actually crippled himself throughout the ages, and as a tool-using animal has actually improved on nature to the extent of providing himself with all sorts of extra limbs and organs. The telephone, for example, is in its fundamental sense nothing more or less than an extended ear, by which we can listen to conversations between New York and San Francisco. The pencil and the pen are peculiarly shaped fingers with which one can make marks. Man himself—the animal—cannot cut steel, but with the machine tools, etc., he uses, he has provided himself limbs whereby he can mold the metals according to his fancy.

"One great result of the work of Major Gilbreth and his colleagues will be that the cripple will no longer be relegated as an outcast. He will be treated as an honorable member of society, for just as there is no stigma attached to the manufacturer who is out of date with his deficient machine tools, so there should be no stigma attached to the man with deficient limbs.

"In order to deal with this problem constructively, each engineer, each designer should take his own particular work and see what he can do in his sphere to make his machine available to those crippled. It is possible to design very simply and very cheaply the slight modification to the existing motor truck, so that it can be operated by a legless man or a man with one leg, or a man with one arm, or similar variations."

Eugene R. Pike[1] related some of the experiences of the city of Chicago in its endeavor to re-educate its crippled citizens. An investigation and survey of the question was made with the object of determining the best methods that would serve the purpose, the probable expense of installing such methods, and also the securing of an estimate of the advantages which might reasonably be expected to accrue from the establishment of such methods of organizations.

Mr. Pike further continued: "During our investigations we found in one industrial plant alone, where an average of from 5000 to 10,000 men have been steadily employed, that the records in the office of the company's surgeon show that during a period of 30 years' operation there were 35,000 surgical cases resulting from injuries received within this plant. This indicates that one out of every seven or eight of the employees received an injury requiring surgical attention, and when the fact is stated that this plant is one of the modernly equipped plants in regard to safety appliances, we commence to realize what this question means to the average equipped industrial plant and the country as a whole. Most of these cases, we found, left the victim of the accident usually 'crippled for life' in some degree, ranging from the loss of a portion of a finger to the total loss of a hand, or leg; loss of sight in one or both eyes; of even the loss of several members, and in practically all cases it seems to be the irony of fate that the injured or lost member was the member that was chiefly relied upon by the victim in the earning of his living and the performance of his work."

The investigations have led to two conclusions, namely: (1) The problem should be handled as a re-educational problem along local lines, because local conditions vary throughout the country, but each local organization should coöperate with a national association of a similar nature; (2) the re-educational requirements of this class of work are very closely related to the present public-school system, in which manual training is provided for both young and old.

The Board of Education of Chicago has already under consideration a plan submitted by the Comptroller's Department that contemplates the use of technical high schools, and the employment of qualified experts for the following purposes:

1. The training of instructors in this new education and science;
2. The manufacture and instructions of the use of artificial limbs;
3. The adaptation of mechanical appliances to the adjusting of the cripple's remaining physical members, so as to replace those that were lost and assist the artificial limbs in the furtherance of physical functions;
4. The re-educating and scientific analysis of any crippled persons so as to fit them to do work for which they are best suited, mentally and physically, thereby still retaining for the use of the country the brains and ambitions that are not injured, for which there is an ever-increasing demand in industry.

The Department of Public Welfare of the city of Chicago has undertaken the making of a survey of the civilian crippled and the maimed of the city of Chicago, and also the making of arrangements for the placing of the re-educated cripple when he has been properly equipped and re-educated by the re-educational school in occupations of worth.

C. W. Rice outlined the work of the reclamation of cripples in France. The work is centered in the so-called National

[1] Comptroller, City of Chicago.

Office of Cripples and Re-Formed Men, an organization belonging to the Ministries of Labor, Interior, and War.

The work is carried on along very broad lines, and its importance is fully realized. After the war of 1870-1871 in France there were only a few thousand wounded and only 2700 men who had undergone amputations. It is estimated that in the present war by March 1, 1916, in all the belligerent countries there were about 3,000,000 cripples, and, in round figures, 10,000,000 wounded.

The professional re-education of cripples is based on the following principles: In the first place, all cripples are divided into two main classes; those capable of such re-education and those who must be taken care of by various forms of assistance, such as pensions, soldiers' homes, etc. The division is along purely economic lines; those capable of re-education being the men who, in spite of their crippled state, still represent a social value close to normal. It is estimated that about 80 per cent of wounded belong to this class.

The treatment of such people is divided into the following branches:

1. Purely medical treatment, in the widest sense of this term, with the view to bettering conditions.

2. Development of artificial organs to take place of those lost or incapacitated.

3. The invention or development of new tools or even new methods of production, so designed as to utilize the limited ability of the cripples.

The vocational selection, or, as it is called in France, industrial orientation of the cripples, which means direction of their efforts into lines where they may be most useful, together with means for finding jobs for re-educated cripples, forms an important part of these new activities.

The entire spirit of the work is to give men wounded in the defense of their country means to continue a useful existence and take part in the industrial life of the nation, and it is believed that this effort will be materially helped out by the great impending scarcity of labor throughout the world.

C. N. Underwood gave an interesting talk, illustrated by motion pictures, upon the remarkable case of a crippled employee at the factory of the Remington Typewriter Works. For thirty-seven years he was afflicted with sciatica and inflammatory rheumatism, and now he is a cripple from bust to knees, with the exception of his arms. After being given up to die by a council of five physicians, four of whose funerals he has since attended, he learned the trade of jeweler. Previous to his affliction he had been a machinist. He is now an operator in the experimental department of the works, and runs any kind of a machine. He works sitting or standing.

The motion pictures showed the man at his work as an inspector of typewriters, and also dexterously performing some of the everyday operations of life, such as dressing and undressing, for which purpose he has designed very clever devices. The joints of his body are rigid, so that he is unable to bend, and therefore he has devised tongs for picking up articles from the floor, for drawing on his socks, etc. He uses the point of his crutch for removing his shoes and socks. The crutches are of his own design. At the top is a ring on swivels which enables him to let go of the crossbar of the crutch and work at the machine without any danger of the crutch getting away from him. By letting go of the crossbar and supporting himself by his forearm on the ring, he can carry objects which he could not otherwise grasp with his hands on the crossbar.

Mr. Underwood said the man was not only one of the most skillful workmen in the factory, but one of the happiest, and the only thing that arouses his anger is the sight of some cripple begging.

Mr. Underwood also showed the rapid work of a one-armed clerk in sharpening his lead pencil, making entries from time cards on to schedule sheets, making entries in a small book, on tags, small cards, etc. He holds the paper on which he writes with the little finger of his hand.

Dr. A. Cullamore[1] held that the problem discussed by Major Gilbreth was not as simple as his treatment might seem to indicate. The problem in reality is twofold: first, training the cripple to function in the economic life of the community by making him capable of doing productive work and earning his daily bread; and second, which is perhaps of even more importance to the cripple, and to some extent to the community in general, making it possible for him to take his place in the social life of his community. He should be able to derive real satisfaction from life and to enjoy the fruits of his labor on a par with his fellows.

Dean Cullamore continued, "In training a cripple to earn his living, intense specialization is the keynote. We must not strive to ape or duplicate nature in any degree, but, as is pointed out in the paper, to find the one best way on the basis of merit alone. We must transcend nature in every case, and that is the job of the engineer. This is perfectly possible. One instance will suffice. The human eye is good, perhaps best, for general purposes; but when a high degree of specialization is desired, we turn to the telescope, the microscope and the camera. In this specialized work the man with two normal eyes is a helpless cripple—that is, from the standpoint of a cripple.

"What we want in vocational education is abnormality. Specialization seeks to produce abnormality along predetermined lines. Abnormality means specialization. Our problem is not to make a man normal, but to take advantage of his abnormality for his own benefit. These cripples are then to be specialists, that is, their specialization has been forced upon them. Therefore, let us treat them as such and see that we devise instruments to make their specialization commercially possible and profitable. That is our whole function in this regard.

"For years we have made clumsy attempts to equip men who have lost limbs in a way to produce normality believing that this solved the problem. Nothing could be further from the truth. Economically, specialization or abnormality is success.

"Why not be scientific, and determine the equipment on the basis of the merits of the case. The wheelbarrow was invented for a two-armed man, with one wheel and two handles. The express wagon, however, has one handle and four wheels, and will maintain its balance. Our purpose should be to determine the case on its merits alone.

"Another point not generally taken into consideration is the change in the normal psychology of an individual which comes with the crippling. To every man who has been crippled two things must be shown which are of equal importance to him: first, that he can earn a living; and second, that he can enjoy the living thus earned normally with his fellows.

"The time to do this is before the psychological change has been formed—to forestall it rather than later to have to modify it. It should be done in the hospital, and it can be done by these moving-picture studies, if they are put across in the right sort of form."

[1] Dean of Engineering, Delaware College.

D. McMurtrie,[1] director of Red Cross cripple work, discussed some of the factors that must be generally taken into consideration in fixing up the cripple.

There are the human considerations. The war cripple is extremely discouraged at first, and the friendship and confidence of each individual must be gained before anything further can be done. He must be started along the right path by the right people. There are a good many difficulties in getting a man to come around to the position where he wants to go out and earn his living and do his full duties. Soldiers especially have been leading a life that is absolutely different from that of the civilian. They have been relieved of certain responsibilities, and have shouldered other responsibilities, so that when a man comes back who has been three years at the front, he has been where he has not had to think where his breakfast will come from, nor of where he would get his next suit of clothes. The first task will be to rebuild his initiative and his economic responsibility.

Another point is that the cripple's difficulties are not always of his own making, but are caused by the attitude of the community. First it pities him, and offers to extend charity instead of giving him a chance to hold a job. Until that attitude of the public changes, war cripples will have a very difficult time.

In considering the choice of trades for a cripple, the general principles to be followed are that the trade must first be a growing trade, not one in which employment is growing less rather than greater. It must be a trade that the man can follow in spite of his handicap, and it must be one in which he can hold not one job only, but a thousand. There has been a tendency in providing work for war cripples to devise special lathes and machines for the cripple; but if that is carried too far, a man who loses his position will be unable to go out and get another job in the labor market.

The man's former experience and education must also be considered, and if he is to be prepared for work that his past experience has equipped him for, he is being done an economic good. The day of the pension is past, and it is realized now that the first duty of the nation toward the returned man is not to pay him a pension, not just to entertain him and regard him as a hero, but to give him the best possible chance to get and hold a good job. Plans are now under way so that the American soldiers will be treated in that way rather than in the way that they have been treated in the past.

Fred J. Miller recalled a statement by a medical authority that a great many men who have amputations of a limb were thereby improved physically and mentally; that they were apt to be more vigorous and better men than they were before. The theory underlying this seems to be that the human machine was first devised for an entirely different life from that which we now lead; limbs were given us for the purpose of actively pursuing game by our own strength, running and leaping and tussling in a general way, and climbing trees. We do not do that very much any more. In consequence, we have an engine department, so to speak, consisting of the stomach, lungs and heart, designed for a different kind of work from that it now does; and if we amputate a limb, we have still the same department for producing energy that we had before, and the result is that a greater amount of energy is poured into the remainder of the body and evinces itself in greater activity. Mr. Miller cited a number of cases that he had found in confirmation of this opinion. He also believed that this had a bearing on the question of whether a maimed limb should be amputated or whether the surgeon should choose with the consent, and usually at the earnest request, of the patient to save the limb if he possibly could. He cited a case where a man's leg was seriously injured. He kept the leg; it was saved by skillful surgery, but was not much of a leg, and it bothered him a good deal for years and sapped his energy. He finally had it amputated, and he is in better health today than ever before. Thus from the layman's viewpoint, Mr. Miller said, there is perhaps too much anxiety to save limbs that have been injured when the patients would be much better off without them.

Dr. C. A. Waldo[1] pointed out that some method must be found to conserve, analyze and carry to a proper conclusion the valuable work in the re-education of the cripple that so many national organizations have begun. The value of the work of the efficiency expert and the importance of the investigations of the particular expert who, for mechanical ends, is trying to make man himself a better physical machine is self-evident. "Our human efficiency engineer is thus our best altruist, as he is never happy unless he is making his neighbor happier."

Obviously, in no direction at this particular moment can the services of the efficiency engineer be more welcome than in his efforts to rehabilitate and save the crippled soldier. There is a great volume of material already prepared along these lines, both at home and abroad. This material should be analyzed, arranged properly and in logical order, tabulated and indexed. It should be published by some nationalized center and should be distributed gratuitously from a national center.

The nation should be deeply interested in this work simply as an economical and paternal duty. We cannot at present reasonably expect to see the end of this gigantic struggle as victors until at least two millions of our men have been under fire. In that event, according to present statistics of casualties at the front, from three to five per cent of the forces will be disabled. If the number is placed at the average estimate of four per cent that would mean almost eighty thousand cripples. If the Government can partially or wholly restore these cripples to the productive ranks of society this would save a pension per man, say, of $250 per annum, or a total pension tax of $20,000,000 per annum or interest at four per cent on half a billion dollars, and as a result this army of 80,000 would be changed from a horde of dependents left to fade away in sickness, gloom and despair into a happy, contented group of cheerful, hopeful citizens.

Edward Robinson spoke approvingly of Dean Cullimore's suggestion that in the education of the cripple, not only should his vocational education be considered, but his general education as well, to fit him for the social life of the community. He regarded education as one thing and vocational training as another. The former is a general thing that takes a long time, the latter a specific thing that can be done very quickly with the aid of efficiency methods.

He was interested in the problem because of his connections with the University of Vermont, which he believed has received a request from Washington to prepare to take up the work of educating crippled soldiers, and he desired suggestions as to how a university could best handle the problem.

Dr. E. E. Southard,[2] speaking from a psychopathic viewpoint, said that he pretended at least to be a social engineer,

[1] Editor, *American Journal of Care for Cripples*, New York.

[1] New York City. Formerly Dean of Engineering, Washington University, St. Louis, Mo.

[2] Psychopathic Department, Boston State Hospital, Boston, Mass.

being a director of a psychopathic hospital. He pointed out how abnormal and unusual conditions have given educators opportunities to open new fields along educational lines and he thought that the crippled soldier afforded good material for study not only in the mechanical field but also in the physical direction. The study of mental disease is going to be pushed into general practice. Everyone is going to talk in terms of mental cripples and is going to realize what he suspected long since that he himself is some particular kind of mental cripple. He said:

"In working with the feeble minded it has been my problem to try to find, so to speak, the minimum amount of brains with which one could do the maximum amount of work. The schools for the feeble minded are precisely the places in the world where the best work is being done with the least brains. The normal school child is not being taught up to the normal, but the feeble-minded children are. We have got to work in that direction in the crippled-soldier problem."

From the viewpoint of psychology the speaker believed that Major Gilbreth's method of analysis corrected a fault of psychologists. These men do not believe that matter exists, or, at least, they do not like to talk of matter, which is tantamount to the same thing, and they, therefore, measure nothing but time, and all their work, therefore, appears to suffer from lack of measurement of space. The author not only points out the theory that we must make measurements, but he goes ahead and measures both time and space.

Dr. Southard took issue with the speakers who said that one of the great problems was to make the crippled soldier contented. There are many people who do not want to be contented. They take pleasure in being blue. There is no happiness that can be regarded as what we all want. In his experiences with psychopathic cases he had found this to be exceedingly true, and he believed that it would also be the case with the cripple. The primary emotions of fear, anger, sorrow and joy, as outlined by the behaviorists, have each to be treated differently, for each reacts according to its inherent composition. Combinations of these emotions need very careful attention. At the Psychopathic Hospital he had had the opportunity to observe how differently people of the types mentioned above reacted in the face of certain stimulus.

In conclusion, Dr. Southard said that the work upon the deficient, upon the crippled, upon the people with the minimum of capacity, with the maximum output for that capacity was the big problem of efficiency, and it was the relation of the output to the amount of energy put in that would have to be studied along research lines from the viewpoint of sociology.

Miss Sarah Cox Johnson[1] emphasized the importance of the psychological side, which, she said, could be expressed by the homely old saying that you can lead a horse to water, but you cannot make him drink. Likewise we may prepare what we think is the right occupation or industry for a crippled or maimed man, with the aid of such expert advice and help as Major Gilbreth is able to give us, but all of that will miss its mark unless the man is saved from himself while he is in the hospital during the period of convalescence.

In a demonstration which Miss Johnson had been conducting on Blackwell's Island during the past year, she found the most difficult problem to be the human element—human emotions, the human mind. A man may come to the hospital and after having been relieved of the responsibility of earning a living and realizing that he, perhaps, may have to go through life maimed and crippled, must have his courage buoyed up and his self-reliance helped at the right moment, otherwise his despondency will settle into apathy and his apathy into a state of willing dependence and he will become thoroughly institutionalized. Here is where a woman's intuition plays an important part.

Alluding to the question of occupations for cripples, Miss Johnson said that handcrafts had generally been used. A great deal of misdirected energy was put into that field since people generally thought handcrafts to have been without craftsmanship. In so far as the craftsmanship is poor, the therapeutic value fails. It is important that in the hospital the occupations of the soldier should be taught by people who themselves are craftsmen, and in addition have a general knowledge of the facts of nursing and health, and a good grounding in psychology.

Whereas occupational therapy has been used for more than a hundred years, it has only recently begun to come into its own, and there are no places in the country for training teachers in therapeutics outside of the few institutions which have trained their own teachers. It will be of interest to know that Columbia University, Teachers' College, is the first college in this country to put in a course for the formal training of teachers along these lines.

Miss Edith M. Valet[1] spoke of the work of the New York Branch of the Association of College Alumni, which has recently offered its services as a committee to help the work of the Red Cross Institute. Their aim is to try to deal with the cripple in the ways Miss Johnson, Mr. McMurtrie and others have suggested.

David Beecroft[2] stated that for some time we have been confronted with the problem of the dilution of unskilled labor, which is closely related to the subject of handling the maimed, and as a consequence of the war both problems are going to demand our attention in the near future.

L. P. Alford suggested at this point that perhaps it would be well to redefine the objects of The American Society of Mechanical Engineers, as the session on management, with its discussions on psychology, physiology and allied subjects, showed, as Professor Kimball said, that mechanical engineering included everything in the world.

F. A. Hannah said that thus far the discussion on the subject had been from the point of view of the supply of cripples. He was interested in it from the point of view of the demand for cripples. As a consulting engineer, he had some clients who had anticipated a shortage of labor due to the draft and the demands of the Government for all employes who could be used on the special war activities.

Mr. Hannah further continued: "I have one client in particular whose business is well adapted to the use of cripples. He has a continuous process, consisting chiefly of machine-tending operations, which turns out a food product. The operations are comparatively simple and thoroughly standardized. We are now analyzing the operations on this machine and are drawing up certain specifications for a cripple. For example, we take a machine and we study it as carefully as we study men. We say that it should be tended by a man with one good leg and one peg leg, one arm with a good hand on it, twenty-five per cent of his sight and no hearing. Thus in a fairly standardized process we can go all the way through

[1] Department of Charities and Corrections, New York City.

[1] President, New York Branch of the Association of College Alumni, New York City.

[2] Directing Editor, *The Automobile*, New York, N. Y.

a plant and draw the specifications for every single operation on every machine."

Mr. Hannah then asked if anything had been done by the author along these lines.

Major Gilbreth answered that the simultaneous motion cycle chart was gotten up with the idea in view of showing all the faculties and all the limits of the worker, who is considered as a society of working members rather than as an individual, and thus a survey of the machine as a demand for motion and a survey of the cripple as a supply of motion will enable one to see whether the two coincide.

W. E. Symons also discussed the question, emphasizing the part women will play in the re-education of cripples and citing a number of his experiences with men who had been improved both materially and mentally by having been crippled.

Walter N. Polakov believed that the problem of the crippled soldier was absolutely inseparable from the problem of the labor market at large, and he thought that the Society, and Governmental and Red Cross institutions that are interested in the work, should submit the question to the labor organizations.

Arthur C. Jackson was of the opinion that it was necessary to create public opinion favorable to the employment of the cripple, and this could be done, he thought, not by having the deliberations of this meeting limited to technical publications, but by writing extracts for popular literary magazines which would create public opinion favorable to the employment of the cripple, so that it would be considered a patriotic action to place the cripple in a workshop especially prepared for his occupation.

Major Gilbreth replied to the salient points of the discussion, particularly emphasizing the fact that the crippled soldier is only a very small part of the crippled population of the country. The industrial cripples, the cripples from birth, from disease and from accident in reality comprise the problem that is ever growing in importance, a problem that includes wide and varied considerations.

# MACHINE SHOP SESSION

## Topical Discussion on the Subject of Inspection, Which Has Developed a Great Importance in Connection with the Matter of Inspection of Munitions

A SESSION was held under the direction of the Sub-Committee on Machine Shop Practice, Prof. Howard P. Fairfield, Chairman, for the discussion of one of the subjects most pertinent to the successful production of munitions—the subject of inspection. This meeting was arranged as a result of the unusual interest at the last Spring Meeting in problems of munitions manufacture which were discussed at that time; and in order that there might be a better understanding between manufacturers and government officials of the requirements of inspection and of its proper functioning with the other processes of manufacture.

The discussion was opened by three introductory talks: by A. L. DeLeeuw on the Logic of Inspection; by F. A. Waldron on the Relation of Inspection to Product, and by Colonel B. W. Dunn (presented by Major A. W. Erdman) on General Principles of Government Inspection and Relations Between Inspectors and Manufacturers.

### THE LOGIC OF INSPECTION

BY A. L. DELEEUW, PLAINFIELD, N. J.

MR. DELEEUW held that inspection is logical and necessary in our present mode of manufacturing, advantageous to manufacturer and inspector alike. Speaking first of interchangeable manufacturing, he said that while Americans had been patting themselves on the back because they thought they excelled in this direction, the fact was that the war requirements had shown that deficiencies existed in the matter of inspection.

Interchangeable methods of manufacture is a broad term, because it refers to two rather different things. Products can be interchangeable as far as design or use is concerned; or as far as individual details are concerned. For instance, it makes very little difference when we get a refrigerator of a certain size and make; whether it is this or that one or the other one. All of them will fill the bill equally well. So it is with a kitchen stove. In this sense refrigerators are interchangeable. To a certain extent even, perhaps different refrigerators of different makers are interchangeable. This is merely interchangeability of function.

But there is another kind of interchangeability. For instance, take the kitchen stove. If one of the lids breaks one simply sends to the maker for another lid which is interchangeable with the previous lid. Again the maker of pipe organs builds in groups or units, and he can build up a more or less complete organ by assembling a greater or less number of these groups. This is interchangeability of design.

On the other hand, two lathes of the same maker will interchange as far as use is concerned, yet may not fully interchange as far as the parts are concerned. He would hesitate to take a carriage from one lathe and put it on another and expect to produce a good turned-up piece. He would be rather afraid of doing the same thing with the headstock, or even with the spindle. He was not absolutely sure that he could do it with the leadscrew, although in some cases he might be able to. He would be more certain of replacing one of the gears with a new one but he was not quite sure that he could use the same key.

So here are different degrees of interchangeability: interchangeability of the entire product; interchangeability of groups and completed details; interchangeability of the pieces; and then interchangeability of the details of pieces, such as keyways, screw threads, and so on. In order to accomplish the highest possible in interchangeability, we must take up the matter of inspection.

#### THE BEGINNINGS OF INSPECTION

The speaker then traced the development of inspection methods, beginning with the "olden times—not so very old either," when a complete machine was built and inspected by one man with the only criterion that it should do the work satisfactorily that was assigned to it. Later came the con-

tract system with the foreman as inspector; still later the system of progressive inspection where each workman was the inspector of the previous operation done by another workman; and finally the modern method where inspection is considered an actual operation in the production of parts.

As inspection became an operation in the shop, there was a natural tendency, also, to consider it among the burdens of the shop, due to the fact that "the man who holds the bag" likes to cut out things, but doesn't like to cut them in. While inspection as an operation makes it possible to produce on a large scale with less labor expense, this does not interest the man who holds the bag half as much as the fact that he has to pay actual cash to "fellows who take a lot of good stuff and throw it into the scrap heap."

Another thing that has set our minds against inspection is the fact that some fellow who can't even run a lathe and doesn't know the difference between a headstock and a tailstock, actually takes a piece on which an A1 lathe hand has spent two hours and says it is no good, and out it goes. Now, that is very aggravating. Nevertheless, we really ought not to blame the undertaker for the death of the man who is to be buried. If anybody must be blamed it should be the doctor. Neither should we blame the inspector if a piece is bad, although it is the inspector who buries it.

There is, however, some reason behind our dislike of the average inspector. There are cases where the inspector shows a woeful lack of intelligence. But if an inspector lacks intelligence, we should blame ourselves, because we expect something from him for which we do not pay. The man who does the detail inspecting for instance, takes a shaft, which he sticks in one end of the limit gage and then turns the gage around and tries it on the other end. If it goes on at both ends, he says it is no good. He takes another shaft and it goes on at one end and not at the other, and he says it is all right. That is all that that inspector is paid for. He is in effect an unskilled laborer who has been taught that one little repetition operation; and if one puts the proposition up to him to decide whether he should reject a shaft when it doesn't go in the gage, we are expecting from a laborer what an engineer should decide. If there is doubt as to whether the rejected shaft could not have been used, we should blame the man who set the limits or the man who made the gage, and not the inspector.

### SPECIFICATIONS AND INSPECTION

Mr. DeLeeuw further said: "This brings me to the main point of what I want to bring out, and that is that the great trouble in the line of inspection is not so much with inspectors as with specifications, and in this connection I am speaking of the detail inspector who makes the interchangeability of manufacture possible. This is a serious subject, and it may not be amiss to tell a few of the things that are required of the inspector, for which he has absolutely no training.

"A few months ago I was in one of the biggest aeroplane factories in this country, and saw a man testing the long beams which form the main beam of the wings. These beams are of spruce, and generally speaking, are in the form of an I-beam. It receives most of the load. The man inspecting these beams had half a dozen laid out on a pair of horses. The beams were perhaps twenty feet long, and the horses nine or ten or eleven feet apart, a distance that might easily vary from day to day. The inspector laid the I-beam flat—not the way it was to be loaded, but flat. The man was very vigorous and took hold of the beam in the middle and punched it down three or four times. Sometimes it cracked before he got tired and sometimes he got tired before it cracked. If it cracked before he got tired he would throw it out, that is to say, he would throw it out if it was completely broken. Out of six that I saw him inspect, two broke and two cracked, but his ears were not as good as mine, he probably did not hear them crack, so the two cracked ones were passed along. Of course one can blame the inspector, but is not the real blame to be placed upon somebody above him who made him do this thing? Here is inspection without any inspection whatsoever."

Then, the speaker said, there is sometimes inspection according to specifications, which is a little bit worse. He illustrated this with anecdotes relating to specifications for belting which he said had been drawn up by the engineering force of some of the biggest concerns in the country, "not all the jokes coming from one concern." The specifications abounded in requirements which it would be impossible to check, as for example, that "all butts used in belting shall be of No. 1 selection; that the belting shall be of native packers' steer hide class; that the leather shall be stretched on straight-edged clamps; that centers and sides must be stretched separately; that the scarfing, joining and cementing shall be done by experts; that the finished leather shall be smooth to the touch on both sides; that the leather shall show no excess in the amount of material soluble in water or in ash, etc." Upon these he gave interesting running comments showing the futility of any specifications so phrased that it is impossible to check the requirements by a proper inspection of the finished product.

This kind of inspection, based upon indefinite or impossible specifications, becomes a matter of much annoyance when it relates to the finish of machine parts. "In a way we have grown used to a beautiful finish on various kinds of machines. The style of beauty varies somewhat. The style of beauty most appreciated in a self-binder, for instance, is a bright red with yellow streaks or green stripes; the style of beauty most appreciated on the bearing surface of a milling machine column, where a perfectly smooth bearing is wanted, is one which has spots on it and has been hollowed out by the use of a scraper. It is up to the inspector to say whether the finish of the machine or of the machine detail meets the ideals of beauty that the public has in its mind. It is exceedingly difficult for an inspector to do this without a standard by which to inspect; and yet I do not believe there are many shops that have standard pieces of finish which from time to time are renewed and inspected by the man who is to be responsible for selling the products."

### STANDARDS AND INSPECTION

Another instance that had come within the experience of the speaker further illustrated the difficulty encountered where dependence had to be placed on the judgment of the inspector without an adequate standard for his guidance. He said in part: "A new machine was put into use for making a certain kind of screw heretofore done on another machine. As far as I could see the screws were all right, but the inspector promptly rejected the first one hundred. I sent them upstairs again with the request to hang tags to the individual screws showing which were wrong and which were right. Sixty-seven were wrong and 33 were right. I numbered the tags and made a list of those that were wrong. I got out another one hundred screws from the stockroom done on the old machine, and all inspected, hung also 100

tags on them, numbered them from 1 to 200, and made a list of them so that I knew exactly which were the old and which were the new. I sent the 200 screws up to the inspector and he sent them back with his mark as accepted or rejected, and I found that out of the 100 new ones there were now 33 rejected and 67 accepted; just the reverse of the other figures, and of the 100 old ones, which had once been all accepted, 75 were rejected. Now, that is the sort of thing that has to be checked. Really, the inspector was not to blame, because the ground on which he rejected them was roughness of thread. It is a very hard matter to say exactly twice in succession whether a thing is rough or smooth enough, especially when one considers that he may have accepted some of them Saturday morning and some Monday morning. There is a big difference there.

"One thing must be remembered when talking about inspection: Inspection does not aim at perfection; the aim of perfection is imperfection. Its aim is to make the imperfect serve the purpose required. We set limits beyond which the piece shall not go and set as wide limits as possible within which we will receive imperfection. Looked at from this standpoint, it will be found that the office of the inspector is not merely the office of a trouble maker but that he is really a useful member of society.

"The things that I have mentioned are merely surface indications of a great problem which we have before us. Most of us believe that inspection is absolutely necessary, but as a whole, the problem of inspection is still in the dark and we have not so far tried to put it on its feet. We have not, for instance, laid down standardized rules as to what specifications should be given, say on the drawings, to enable the inspector to do intelligent inspection without being a professor or a Solomon. We have got to the point where we are willing to make plus and minus allowances, but we have not got to the point yet where we are willing to make the plus and minus allowances as big, or, I should say, as convenient as possible, because the mere making of an allowance big enough does not always solve the problem.

"This is an engineering problem pure and simple. It is the problem of subordinating every piece and every detail, every dimension of the piece to our system of manufacture. Before the drawing is sent to the shop we should have a special inspection in the drawing room, going over every dimension with a view to subordinating it to the system of manufacture in vogue in that shop, and we further should scrutinize that system with a view to its being the most economical possible. There are certain things in inspection which make it more apt to be a failure than almost anything else. In the first place, it is a repetition operation. In the second place, there are many things the inspector has to inspect for which he has no absolutely definite data, and he has to follow his own ideas or notions. It is therefore necessary that the inspector should be controlled, and that his inspection should be inspected and checked.

"We ought to select our inspectors with great care. As a rule we can find them among our workmen. We sometimes find workmen who are not very productive just because their ideas are a little bit strict. Such men may easily be trained into detail inspection. We should try to get the chief inspector as broadminded as possible, but I do not believe it will ever be possible to depend on the broadmindedness of the detail inspector. There should be in the inspecting organization, either in your own shop, or among Government inspectors sent to a job, some man who is enough of an engineer, and also enough of a human being, to have the broadmindedness to look at things not merely from the standpoint of filling certain specifications, but from the broader standpoint of whether or not a piece is useful, because even in Government specifications there are cases where a piece may be useful and still might be rejected on technical grounds."

In conclusion, Mr. DeLeeuw spoke of the importance of gages, which, like the pieces they were to measure, should have limits, and should be checked by master gages verified from time to time by some authoritative source of the Bureau of Standards at Washington.

## THE RELATION OF INSPECTION TO PRODUCT

BY F. A. WALDRON, NEW YORK, N. Y.

IN continuing the discussion upon the subject of Inspection, F. A. Waldron mentioned that one of the disappointed contractors on munitions work, who had recently called at his office, had remarked that nothing could be said on "the relation of inspection to product," because no such relation existed. Another engineer had said to him that the relation of inspection to product was like that of son-in-law to mother-in-law, which suggested to him the possibilities of the subject. Then he began to think. While in every domestic circle there is the question of mother-in-law and son-in-law, if trouble exists it generally is on both sides; so he considered that, after all, the subject of his discussion was not as barren as it might seem.

Mr. Waldron said he would start at the beginning, and, accordingly, indicated the necessary steps in the production of a commodity by the accompanying headings:

IDEAL
IDEA { Invention / Engineering Design
DEMAND
MANUFACTURE
Purchase
Inspection

Imagination, which Napoleon contended "rules the world," takes form in the *ideal*, and ideals are what men fight for and what we are fighting for. The *idea* is the next stage to the ideal; one tries to make it approach the ideal. The idea is developed by *invention*, followed by *engineering design*. Then comes the *demand*. Before the thing is manufactured by any one there must necessarily be a demand, otherwise no one would manufacture. Following the demand comes the *manufacture*. Then follow two very important items; one being the purchaser, or *purchase*, and the inspector, or *inspection*. The purchaser desires some article and creates the demand; the manufacturer makes it, and the purchaser, in order to be protected, necessarily brings in the inspector to see that he gets what he is paying for.

The idea, as conceived by the inventor, becomes transformed into the design or engineering device. In the mind of the designer exists broad imagination; otherwise he would not be a designer. He conceives questions of space entirely from an academic standpoint. The question of whether it is ten feet or ten one-thousandths of an inch has no real definite meaning beyond the carrying out of the idea or invention upon which he is working. "There," he said, "is the keynote of the principal trouble in inspection, and the relation of inspection to product, simply substantiating what Mr. DeLeeuw has said."

Having established the design of a particular machine or piece of munitions, the question of manufacture comes up

where some of the biggest troubles occur; and in respect to these, Mr. Waldron said that as he had been both inspector and manufacturer he would try to be fair to both sides. He wanted to emphasize, however, that when a manufacturer who does not know what a snap gage is, nor what one-thousandth of an inch is, takes a contract for hundreds of thousands of duplicate parts, he is making a mistake. Under such circumstances he did not blame an inspector for "kicking" and compelling the plant to produce the goods according to specifications. Such action would do the concern good in the long run. One of the greatest difficulties in the way of the inspector is the manufacturer who is not familiar with the details of his business.

### Relations of Manufacturer and Inspector

In the relation between manufacturer and inspector there is what one might call academic manufacture and inspection; and commercial manufacture and inspection. Academic inspection is where the inspector goes back to the original idea of the inventor and designer, neither of whom may have had any practical experience, and insists on absolute accuracy in accordance with the specifications. The result will be no product manufactured. This represents one extreme.

The other extreme is where the designer understands what dimensions mean; is one who can discriminate where thousandths and where ten-thousandths of an inch are required; who can visualize the processes of manufacture as he writes his specifications; and who is able to prepare the specifications so that the manufacturer and inspector can understand them. Under such conditions the inspector will be helped by the specifications rather than hindered, and if the manufacturer understands his work he will be able to turn out the product.

Trouble is sure to exist where the inspector and designer fail to get together, since the manufacturer, caught between the two, will be at the mercy of the conflicting functions. As an illustration, a concern which has been making hundreds of thousands of scabbards for the government had an inspector who was a specialist in scabbard leather, and as long as he was on the job the production was as regular as the clock. After some time this inspector was transferred, and another inspector was put on the work who had been a specialist in harness leather. Now, harness leather must have considerable grease content and bend easily in order to resist weather conditions and be flexible wherever it is used. This man cut open a piece of scabbard leather, and because it lacked the characteristics of harness leather he rejected all the scabbards. That was a question of the wrong viewpoint, but, fortunately, the difficulty was corrected by referring the matter to the man in charge of that division, who had the inspector changed to some other work. In the meantime the product was stopped for three or four days, which, with a production of ten or fifteen thousand scabbards a day, was quite a serious matter.

### Conditions Rendering Inspection Difficult

The principal condition of design from the standpoint of inspection is to have reasonable tolerances determined in reference to the final functioning of the article to be manufactured. For instance, there may be certain conditions which have no effect whatsoever on the functioning of an article that must be held to very closely because the design so specifies. The inspector is helpless in such cases. It is only in questions of visual inspection that the personal equation of the inspector comes in.

The evil effect of too small tolerances in design goes further than the pocketbook of the manufacturer. It first of all reduces the number of pieces sent to the front for our troops; and in making that statement the speaker said he was not arguing for defective material.

The effect on the cost, however, is serious. The closer the tolerances the greater the cost of tools, gages and fixtures required to maintain the product, especially in the volume that it being manufactured at the present day. When the Government was ordering forty or fifty thousand pieces at a time, and only one order in two or three years, and they were being turned out in their own arsenals, it was easy to meet academic tolerances. But when turning out parts by the million and tens of millions, quantities unheard of before, the wear and tear on the tools and gages is enormous, and the making of gages is becoming an industry almost as large as our producing functions prior to the war. Enormous supplies of steel are required to replace the tools and gages which have worn beyond the limits of the small tolerances established by the department of design, or the engineering department, and we are in the economic position of a possible dearth of tool and high-speed steels. There is already a dearth of tool makers. A man came into a New England town recently and took away nine tool makers at $10 a day each and traveling expenses. Why did he do that? Simply because in some cases the design demands such close tolerances that it is impossible to furnish enough gages and taps and dies to keep up the production of the shop.

### What the Inspector Lacks

While the inspector cannot be blamed entirely for conditions such as outlined, there are some other conditions for the existence of which quite a little blame can be placed on his shoulders. The solution would appear to be, as already pointed out, that inspection should be in closer touch with design—not necessarily in a functional or organization way, but in a "spiritual" way, if one so chooses to call it. Then the inspection department knows just how far it can go without having to refer back to the design. It knows what a piece is used for, and that if a thread is a little rough, but will go into the piece properly, no harm will be done. By such knowledge the inspector will be able to maintain an economic condition of manufacture.

On the other hand, if the manufacturer is trying to take advantage of the inspector and deliberately push through inferior or cheap work, it is then necessary for the inspector to put the screws on for the time being. Some inspectors will lay aside a pile of material, in the initial stages of a contract, for some minor defect; they will not pass it and the equivalent of a large sum of money may lie idle for a considerable time. After the manufacturer has had his lesson the inspector will then gradually take material away from the pile and accept it. Meantime the manufacturer may have lacked funds to meet his payroll. Where such conditions exist, unquestionably there is blame on both sides.

In conclusion Mr. Waldron said it was his purpose to try to bring out fairly the troubles of inspector and manufacturer alike so that in the subsequent discussion each might have his say, make their complaints, and in the end both might be able to get a little closer together, so that the spirit of the design might pass to the inspection department, and the mental attitude of the manufacturer be brought to such a stage that, instead of looking upon the inspector as a disturbing element, he would regard him as a helper.

# GENERAL PRINCIPLES OF GOVERMENT INSPECTION AND RELATIONS BETWEEN INSPECTORS AND MANUFACTURERS

BY COL. B. W. DUNN, U. S. A.[1]

IN accepting the invitation of your Secretary to open briefly your discussion of this subject, it was not my thought that I could add any new facts to your knowledge of the subject. It was my hope, however, that I might succeed in some degree in preventing between our inspection service and our manufacturers at the present time a repetition of some of the misunderstandings that are known to have existed in the past between the inspectors representing foreign governments and our American manufacturers.

It is of the first importance at this critical stage in our history that harmony should prevail among all important elements engaged in promoting our national defense. Differences of opinion are bound to occur frequently between an inspector and a manufacturer. There is no reason why such differences should be at all serious when both parties are actuated by a desire to be just and reasonable. The differences have been most serious in cases where mutual distrust existed between the parties before the differences occurred. In many such cases this previous absence of confidence has been the principal cause of the difficulty. For example, it has been stated that the inspectors of a foreign government, while on their way to America, would drill daily on the steamer for the purpose of enabling them to detect dishonest practices that it was assumed the American manufacturer would adopt. About the same time these American manufacturers were assuming that the foreign inspector would be a grafter. Approaching each other in this spirit, it is not to be wondered at that serious trouble developed in many cases between these inspectors and our manufacturers.

## GOVERNMENT CONTRACTS AND INSPECTION

It seems advisable to explain to you briefly the ordinary development of Government contracts and our methods of inspecting the product. The drawings and specifications for the desired product having been completed by the Design Section located at Washington, the next step is for the Purchase Section to select the manufacturers and negotiate the contracts. In the selection of these manufacturers, the Purchase Section is aided by reports from the Production Section relating to the equipment of manufacturers under consideration, their general standing, their technical personnel, their financial standing, etc. Competition among acceptable manufacturers is of course a controlling feature. The contract having been signed, a copy of it, with drawings and specifications, is sent to the Inspection Department and constitutes a notice to this department to take charge of the interests of the Government from that time on.

Our Inspection Department at the present time is made up almost entirely of men taken from the manufacturing industry. Any branch of the Ordnance Department is lucky at the present time if, in its personnel, it is able to show more than 1 per cent of officers who belonged to the Ordnance Department before the declaration of war last April. As a rule, the reserve officers are men who have come into the service purely for patriotic reasons. In accepting these patriotic offers, the preference of the Government has been for college graduates with the degree of mechanical engineer, and with a practical experience in machine shops after graduation of five years or more, during which the applicant has received a salary materially in excess of the salary paid by the Government for his grade. Many of these officers are now wearing the uniform and receiving a salary considerably less than one-third of their salaries in civil life. The assistants of these officers are civilian employees of the Government obtained through the Civil Service Commission.

The inspecting force at a single plant constitutes a field unit. It consists of one officer in charge, known as the Inspector of Ordnance, at the plant. He has as many assistants as necessary, consisting of junior commissioned officers, chief inspectors, assistant chief inspectors, and inspectors. To bring about uniformity in the action of these field units, we have a number of supervising inspectors, made up, as a rule, of men of large experience and mature age, combined with tact and good judgment. These supervisors have a number of plants assigned to them, and they circulate among them, charged with the duty of thoroughly investigating any complaints made by contractors and observing with great care the activities of inspectors to detect any weaknesses. Twice a month these supervisors meet the officer in charge of the inspection service at headquarters to discuss general features of the work and to promote uniformity in the action of the supervisors themselves.

From the above, it will be seen that any contractor who has the slightest reason to complain of the action of the Government inspector, can secure at once a complete investigation, and, it is believed, a correspondingly just decision. The inspector of ordnance in charge of the plant is required, in case of a complaint, to immediately get in touch with the chief inspector of the plant and to make a joint investigation. Granted that both minds approach such an investigation in the proper spirit, a satisfactory conclusion should be reached in more than 90 per cent of the cases. The supervisor should settle at least 90 per cent of the remaining cases, and when he cannot secure a settlement, only a few hours are needed to bring to the scene of trouble the principal technical assistant at headquarters, and, if necessary, the officer in charge of the entire service.

## DIFFERENCES BETWEEN GOVERNMENT AND COMMERCIAL CONTRACTS

It seems pertinent to analyze to some extent the differences between Government and commercial contracts. The most important one is believed to be the fact that a contractor cannot sue the Government. This is combined with the fact that in practically all Government specifications the contractor is required to satisfy the inspector. The manufacturer who considers an inspector unreasonable must be prepared to prove the accuracy of his charge. If we grant that an inspector is unreasonable, and possibly dishonest, and that his superiors belong to the same family, it is quite evident that the contractor is without adequate protection. The possibility that he may be placed in this position is a source of most of the manufacturer's imaginary troubles, which to him seem anything but imaginary. The absence of personal interest of the inspectors in completion of the contract is another difference between a Government and a commercial bargain. As a rule, the Government inspector has only one responsibility, that of seeing that the quality of the manufacturer's product is up to the prescribed standard. It is no concern of his that the product may be short in quantity. To stimulate produc-

[1] Inspection Section, Ordnance Department.

tion is the duty of another department, the Production Department.

Another very important difficulty to the manufacturer relates to the delays that frequently attend the receipt of funds from the Government. With millions to his credit, the Government paymaster cannot deliver the much-needed check until all requirements of rigid red-tape regulations are complied with. This is the cause of frequent trouble to the contractor who undertakes a greater volume of work than his financial backing justifies.

Another important difference is found in the fact that in commercial work the contractor is generally more accurately informed on technical matters relating to the product produced than is the purchaser. In the case of Government contracts, it is usually the other way. Few of our manufacturers are ordnance engineers, or have on their personnel staff men who understand the reasons for the requirements of Government drawings and specifications. The barrage fire, which constitutes such an essential part of military operations today, is seriously interfered with by any difference in the action of one fired round from another. Our soldiers will march confidently a short distance in the rear of this wall of bursting fragments, their lives depending upon this uniformity in the ammunition. Any material difference in the weight, exterior form, or location of center of gravity of the projectile, in the action of the fuse, or in the uniformity of the propelling powder charge, would be liable to cause one or more of these projectiles to burst well short of the intended point, and in the midst of, instead of safely in front of, our troops. The contractor who honestly thinks that some nicety of dimension called for by the drawings is introduced solely to allow the inspector to exercise his power, may, in this ignorant way, be objecting to one of the features essential to the efficiency of the ammunition.

### Requirements from Government Inspector

The product of the manufacturer is divided by the Government into lots, and for each lot the Government inspector is required to sign a formal certificate, stating in substance that all units of the lot comply in quantity and quality with the requirements of the specification and drawing. It is impracticable for the inspector to inspect each and every unit for each and every requirement. The manufacturer does make a 100 per cent inspection of the product for all dimensions. The plan of the Government inspector is to check the manufacturer's inspection to the extent found necessary, the checked inspection for the more important feature being of course much larger than the less important. The certificate for the Government inspector is required before the voucher for payment of the contractor can be completed. As an illustration of the kind of coöperation that should exist between the inspection departments of the Government and the contractor, I am reproducing below two circular letters that have been issued from our Inspection Department to all contractors manufacturing artillery ammunition.

(COPY)

October 1st, 1917.

From: Inspection Section, Gun Division, Ordnance Office
To: (Name of contractor)

Subject: MANUFACTURERS' CERTIFICATE OF PERFORMANCE

1. It has been suggested that I request manufacturers to submit for each lot of finished product presented for official inspection a certificate on some convenient form signed by a responsible representative of the firm, and reading in substance as follows:

"I certify that Lot ——— ——————— has been
(No.) (Article)
manufactured strictly in accordance with standard machine shop practice; that the components have been inspected carefully by the inspectors of this Company; and that to the best of my knowledge and belief this lot complies with all requirements of the drawings and specifications that apply to it."

2. Some of the arguments supporting this suggestion are:

(*a*) The certificate does not require any change in the present standard practice other than the signing and filing of the certificate.

(*b*) Very exceptional instances have occurred where over-zealous or dishonest subordinates have attempted to resort to questionable practices in repairing or salvaging defective material; and where their immediate superiors have disclaimed responsibility because they were ignorant of the practices.

(*c*) The responsibility of the firm in such cases will be acknowledged by no one more promptly than by the management, whose duty it is to take the steps necessary to avoid this ignorance.

(*d*) It is believed that this certificate will assist the management in establishing in the minds of all of its employees, and especially in the minds of its shop superintendents, foremen and inspectors, a correct appreciation of this responsibility. It is not conceivable that any of these responsible employees can remain ignorant for any length of time of anything relating to the work and practices under their supervision, if they make proper efforts to keep informed.

(*e*) The writer desires the establishment of the most cordial coöperation possible in the efforts of our inspectors and of the contractors to detect and eliminate all defective material, and to prevent errors of judgment in the rejection of good material. Mutual confidence is a necessary foundation for this coöperation. Suspicion will supplant confidence in any plant that does not detect and eliminate the employee who is inclined to conceal rather than to discover and report defects. If it is at all possible to correct the defects and salvage the material by proper, as distinguished from secret or questionable, practices, the Government inspectors will coöperate with the management to that end.

3. About the only criticism presented against the suggestion is:

(*a*) Any dishonest contractor or employee would not mind signing a false certificate, and the honest ones are liable to resent being asked to certify to their honesty.

4. Commenting on the above criticism, it is thought to be superficial. An honest man does not object to being placed on honor. Army officers have a just pride in their reputation for honesty, and they certify daily to the correct performance of various duties. The value of all these certificates is to a great extent educational. They concentrate the honest man's attention on important matters that require special treatment by him. In the production of ammunition for use by our soldiers on the firing line, the prime responsibility to conserve the safety and efficiency of the ammunition rests equally upon all concerned with the production, and all agencies tending in any degree to promote this conservation should be utilized.

5. Please give this subject your careful consideration, and let me have the benefit of your views.

(*signed*) B. W. Dunn,
*Lieut.-Col., U. S. Army, Retired,*
*Commanding.*

Letter No. 2

November 21st, 1917.

From: Inspection Section, Gun Division
To: (Name of Manufacturer)
Subject: MANUFACTURERS' CERTIFICATE OF PERFORMANCE

1. In a former circular letter I asked for comments on the suggestion that we require from manufacturers a certificate similar in substance to a certificate signed by Government Inspectors. While some of the replies reflected some doubts as

to the necessity for such certificate, the suggestion did receive the hearty approval of the majority of the manufacturers.

2. This correspondence indicates that the certificate should be signed by the Chief Inspector in the employ of the manufacturer and countersigned by the Shop Superintendent. The original suggestion was indefinite in this respect, and stated that responsible representatives should sign the certificate. It is evident that the Chief Inspector and the Shop Superintendent are the chief representatives of the company who know most about the actual work in the shop. A slight change is advisable also in the wording of the certificate, substituting "good" for "standard" in describing machine shop practice.

3. General William Crozier, Chief of Ordnance, whose attention was invited to this correspondence, suggested that good results should also follow the placarding of his plant by the contractor with notices inviting attention to the obligation that should rest upon each individual employee to do everything in his power to insure that the product of his plant is of the proper quality to insure the safety of our soldiers and our success in the war.

4. I am therefore inviting manufacturers to submit for all lots of their product completed, after date of receipt of this letter, the following certificate:

"We certify that Lot ——— has been
(No.) (Article)
produced by the use of good and modern plant practice; that the components have been inspected carefully by the Inspectors of this Company, and that to the best of our knowledge and belief this Lot complies with all Government requirements that apply to it.

*(signed)* .....
*Chief Inspector for ..... Co.*

*Countersigned by* .....
*Shop Superintendent.*"

5. It should be understood that the above Certificate is not required of any manufacturer who prefers not to furnish it. When furnished, it should be forwarded directly to this office through the Inspector of Ordnance at the plant.

*(signed)* B. W. DUNN,
*Lieut.-Col., U. S. Army, Retired,*
*Commanding.*

It is my hope that this discussion will result in developing other practical methods for promoting this cooperation.

## DISCUSSION

Sir Charles Ross said that two months ago there had been criticism in this country of a matter in which ammunitions were concerned. While it was not to the point of the meeting he desired to take the opportunity to say that after 16 years of close study of the American Government's Ordnance Department he was filled with admiration for it, and if the details of the ammunition question had been known to the public he felt that the work of the department would have been applauded instead of criticized.

Speaking of the troubles and difficulties which arise between inspectors and manufacturers, he said that he would propose a solution as a basis for discussion, so that if the fundamental theory on which it was based should meet with the approval of the engineers of the Society some practical means might be worked out for accomplishing the desired results. At present there is no means by which the inspection department of the Government can have matters explained to it by some quite impartial persons; and if the manufacturer has complaints to make the odium is at once thrust upon him of making complaints in respect to the inspector, which is a very undesirable thing to do.

In order to overcome that unjust obligation on the manufacturer, the thought is that an independent body should be created, called *X*, in the diagram below. Such a body might be composed of the elected representatives of the engineering societies of America, whose functions should be as follows: (1) to hear the complaints of both the manufacturer and the inspector; (2) to advise both the manufacturer and the inspector, and (3) to make reports to the Secretary of War and the Secretary of the Navy.

PUBLIC OPINION
PRESIDENT
CONGRESS

SECRETARY OF WAR } { SECRETARY OF NAVY
MANUFACTURERS } *X* { INSPECTOR-CHIEF

The speaker believed that such a plan would secure the cooperation of and be welcomed by the Government. With such an organization, questions of proper toleration and finish, questions of samples, etc., could all be passed on.

At a later point in the meeting he presented a resolution for the appointment of a committee whose duties should be as outlined in the foregoing discussion. This finally led to the drafting of a resolution as given below, which was voted upon favorably.

RESOLVED: That the Council of the Society be requested to recommend to the Government the creation of a Board which shall be intermediate between the manufacturer and the inspector, and the Secretaries of War and Navy—the functions of this committee to be as detailed in a resolution offered by Sir Charles Ross and unanimously recommended, viz.:

That authority be given to a committee as follows:

(1) It shall hear complaints:
  (a) From manufacturers.
  (b) From inspectors.

(2) It shall advise inspectors as well as manufacturers upon the proper application of gages and standards of acceptance and rejection.

(3) It shall report and have access to the Secretary of War and the Secretary of the Navy.

R. H. Danforth pointed out that while the question of gage inspection is undoubtedly the question of most importance to those concerned with machine-shop work, difficulties are encountered in the inspection of material which could have been partly eliminated if there had been preliminary inspection. The parts which depend primarily for their acceptability on machining do not usually depend on the material, except in so far as the material determines the usability of the products. To illustrate, a manufacturer of small tools, taps and dies purchased steel under usual specifications and had made practically all of it into taps which were heat-treated and hardened in the usual way. Customers complained that the taps did not wear. An examination showed that ten per cent of the taps were not hard at all, and a chemical analysis of the soft taps proved that instead of being of tool steel they were of cold-rolled stock that had gotten in by mistake.

Another instance was in the manufacturing of automobile parts and drop-forgings, which have to be heat-treated in order to provide the necessary strength with the minimum of weight. A great deal of difficulty was encountered in getting alloy steel within a reasonable tolerance of composition so it would be amenable to heat treatment. In one case a shipment of fifteen-point carbon steel was mixed in with a lot which had been ordered as a thirty-five-point carbon and fifteen-point vanadium steel. After heat treatment, instead of getting 75,000 lb. elastic limit, only 40,000 lb. was obtained. As a result the manufacturer put in a complete inspection department for his raw material. He bought in lots of from 50 to 100 tons and made a chemical analysis of at least every ton.

A great many specifications today are practically impossible to meet. They call for certain chemical requirements and also for certain physical requirements, and unless the latter have sufficient leeway to allow for the maximum allowable variation in the former, or unless the former have an allowance sufficient to take care of the maximum allowable variation in the latter, one cannot produce material with proper characteristics. Thousands of specifications in use today do not take that point into consideration, and therefore are a constant source of trouble to both the manufacturers of the raw material and the finished product, to say nothing of the inspectors who act as the go-betweens.

W. S. Huson said that while we are working for the standardization of products and the standardization of production we are also awakening to the fact that we must have standardization of inspection. This is all the more important, as Mr. DeLeeuw pointed out, because of the kind of labor which must be employed, but the thought had come to him that it is not so much the inspection itself that must receive attention as it is the specifications; particularly for the guidance of the younger inspectors, who lack the necessary experience. Drawings and blueprints should be made to convey intelligent information to worker and inspector; and care should be taken in the designing of a machine to avoid useless and needless precisions.

He further said: "In discussing the broad field of inspection I believe that common sense is not a bad thought to give expression to. The inspector must feel that he is not hidebound by the instructions and the pictures that he has. He must use some gumption and common sense of his own.

"The chief inspector must communicate to those who are under him those qualities which govern proper and intelligent inspection. The day has gone by when 'jacking up' men is the thing to do. A man must be agreeable, even if only in a subordinate position such as that of a junior inspector. He must try to judge the work without bias or partiality and must steer clear of two things: he must not permit the workmen to agree among themselves as to what constitutes the quality of work they turn out, and he must avoid getting into argument with them as to whether it is right or wrong. He must go to the chief inspector, who must be intelligent and efficient enough to know what constitutes the right kind of work, and how far the tolerances can go one side or the other. In other words, today the principle of good shop inspection is not to point out why work is wrong, but rather to try to point out to the men why it should be right, and thereby gain their cooperation."

As contributing to this, the speaker raised the question as to what had been done for factory organizations similar to that which is being done in other fields by technical journals and house organs. Have we to any extent given to the men engaged in manufacturing operations the "whys" and "wherefores" of the work that a machine does, of the products produced and their requirements? While some workmen would profit by such printed matter, others would undoubtedly not, but nevertheless he felt that some consideration should be given to the development of such means of communication to at least show the workers that their services are appreciated.

Forrest E. Cardullo contended in answer to Mr. DeLeeuw that a set of specifications could not be gotten out that would cover entirely, completely and satisfactorily what was needed. No man had sufficient foresight to cover everything that would come up in materials and workmanship and various other things that affect the usability or non-usability of parts. The Constitution of the United States is a set of specifications for government, and there are about 140 volumes of interpretations of it. One cannot prepare a set of specifications for a motor, including materials and parts, or for an aeroplane or a gun, and cover it completely. Room has to be left for the inspector to use his judgment, and the inspector that does not is one of the best allies that the Kaiser has. The inspector should be given authority to waive the specifications. For example, it is all very well to say that a thing should have no surface defects, and it is wise to follow out this specification if the defect of the part is such that it affects its suitability for use. If there should be a tiny sulphur seam in the main bearing of a crankshaft of an aeroplane motor the crankshaft should be rejected, but if the defect is in the crankpin of a certain type of motor the pin should be accepted. In short, it all depends on whether the thing is just as good for use as if it met the specification in every respect, and if it is it should be accepted.

The war cannot be won by specifications or by inspectors. The only things that can do it are guns, ammunition, aeroplanes and various other agents of destruction. The purpose of inspection must be to produce the largest possible volume of military implements and munitions that are suitable and usable for their purpose, and the inspection that fails to do this is radically defective. In his connection with the Curtiss Aeroplane Company the speaker had heard young men in the American Inspection Service say that it was immaterial to them as to what the product was or whether, for example, ten or sixty aeroplanes were produced per week, as long as they saw to it that the "stuff" met the specifications; and if because of that attitude on their part production was delayed, it was unfortunate, but it was no concern of theirs. Such an inspector is a grave danger to the country. The purpose of the inspector should not be simply to reject certain pieces that pass on one side of an imaginary line, and accept certain other pieces that fall short of a certain imaginary line; but it should be to keep up the general quality and quantity of the product.

Inspection should be reorganized on the basis of quality and quantity. We are apt to fall into error in believing that our inspection has to be complete. Our inspector, whether connected with Government or plant, should bear in mind when he is inspecting the product of outside manufacturers that he is there primarily to help bring up the general quality, and when he has reached that point he has then done his duty.

Philip Reynolds[1] stated that he had been connected with ammunition manufacture from three different standpoints; from that of government inspector, the manufacturer and the shop inspector. He had worked on Russian and British work since the crack of the first gun. He had seen pictures of guns that had burst, with all the men either killed or wounded, just because some inspector used too much judgment. He believed that inspectors should live exactly up to the requirements, up to the gages, and that they had no right to use their own judgment at all. Matters of judgment should be submitted to their chief.

Coming down to shop work, he believed if everybody worked on restricted tolerances, that is, lower tolerances than the Government required, there would be very little trouble. He had had no trouble in meeting Russian and British requirements. The boys at the front must be protected. There must be no "prematures," or anything like that taking place.

C. B. Hamilton, Jr., also from Canada, endorsed the re-

[1] Supt. of Inspection, Lymburner, Limited, Montreal, Canada.

marks of the last speaker, and said: "We have been in this war longer than you have, and we are having our boys come back minus arms and legs, and we don't want any of that done with our own shells. We have been accustomed to the barrage fire for some time, and we are beginning to realize the niceties that are required in shell work to make sure that we are not going to have some shells burst in our own ranks; and shell work is only one of the items. There isn't any 'good enough' in this munition business. There have been quite a number of us finding that out, and you people will find it out, too."

With regard to tolerances, he said that it is the practice at his plant to make the limits in the earlier stages of the work less than the government requirements, and to increase progressively as the latter operations are approached until finally they equal the government requirements. If the limits in the early operations are made as wide as they may be, there will be trouble all down the line. The limits in the early operations should be as close as the men can work, even if it costs more money. The money will come back by less trouble in the secondary and later operations.

Mr. Hamilton said that it is further the practice in inspecting materials to do as Mr. Danforth suggested. In some cases analysis is made of a specimen from every half ton of steel, and in a few cases every bar is analyzed. Discrepancies are not all due to accident by any means. A lot of plain, ordinary negligence existed on the part of steel manufacturers.

In this matter of specifications we had better assume that the man who wrote the specifications knows more about the work than those who are just starting the work. The modern progress of shell fire calls for closer and closer limits. We will be working to closer limits next year than we are now. While the production may be reduced, we must have shells that will produce results in Germany and not in our own ranks.

He felt that the specifications quoted by Mr. DeLeeuw with regard to belting must have been selected in a way that gave a wrong impression. There are two kinds of specifications: guidance specifications and inspectors' specifications. The specifications such as Mr. DeLeeuw read are in the nature of guidance specifications, for the manufacturer to take into consideration in bidding, to know whether he is going to be able to produce that kind of goods. The inspector has nothing to do with such specifications.

While he did not want to be misunderstood in referring to things made in the United States, he had been told that shells had been sent to the British Government that were so rough that the revolution or spinning of the shell made the steel act as a rotary file on the explosive block, and produced premature firing.

In response to a question by Mr. Cardullo, he said it had been found that there were a large number of premature explosions among shells that are rough, but when they are polished there is no trouble from that cause.

Major A. W. Erdman said that as far as the Inspection Section of the Gun Division of the U. S. Government is concerned, the contractors are expected absolutely to live up to the specifications as they are written. If there are any points in the specification that can be advantageously changed, if they are called to the attention of the department the officers will be glad to coöperate with manufacturers, but the Government must proceed along these lines. It cannot proceed on the theory of getting a general average of good product.

Philip Reynolds advanced the theory that such explosions, which sometimes shattered the guns, killing every man on the crew, were due to faulty fuses rather than to the cause advanced by Mr. Hamilton. Mr. Cardullo also confirmed this opinion, saying that the consensus of opinion among those at the front was that the cause of premature explosions is defective fuses.

C. E. Coolidge reported that he had spent two strenuous years in the manufacture of munitions in Canada, and had gone over about as many of the hard spots as any of his confreres. Fortunately, his plant, one of the largest in Canada, was located in a district where there was a broadminded chief inspector. They had a large contract for eight-inch howitzers, and they probably had as much reason to find fault with government inspection as did similar plants, but the policy adopted was a broad one.

It was recognized at the start that they must first of all protect the boys on the firing line; secondly, they must protect the government; and thirdly, they must protect the manufacturer. This must be accomplished through a spirit of coöperation all around. While it is an ancient tradition that the operating and the inspecting organizations must be arch enemies, with a sort of dead line between them over which neither must step, such a spirit can produce only unsatisfactory results. It is the policy in this particular plant to consider that the government inspection corps and the shop inspection corps are practically one.

The speaker said that he had organized the shop inspection corps and had made it plain to every one of the inspectors that they were part of the government staff, and also advised the chief inspector for the government to take under his wing to a certain extent the company's inspectors. In that way they constituted one happy family. In order to overcome ill-feeling between inspectors and the machine operators, inspectors were assigned to each machine and they were told that they must be friendly to the operators and should coöperate to the limit. The spirit in that plant is of this kind. Every one feels that he is doing his little bit, and each one that he is the man behind the man behind the gun.

Charles E. Davis had found that when the fact was established in the minds of the inspectors that the truth was wanted from whatever source it could be derived, friction disappeared and production increased. He had found this to be particularly the case in connection with fuse construction for the British Government. Their assistance on many questions was needed and invariably when a point was reached where there was a question in regard to the product, they were told "We want to make this test, and we want your inspector with us when we make the test." They coöperated and gave every opportunity, and the result of their experience at every point, and the percentage of loss was reduced to a very low percentage. To his mind it was first necessary to establish in the design of a piece or a machine the vital functioning points of the product to be produced; then to establish the limits of variation that will give these results reliability. Hold to them rigidly. On non-essential points cover the matter as carefully as you can.

Major A. W. Erdman said that inspecting the functional points as outlined by Mr. Davis, was exactly the line along which their Inspection Section was working. For instance, on the twenty-one-second time fuse he thought there were 45 distinct metal parts, and there were something like 240 gages required. In the factories which have had years of experience in making these fuses the government was inspecting with thread gages to be sure the fuses would screw into any shrapnel.

Philip Reynolds[1] wrote that from his experience with the manufacture of Russian and British shells he believed that in the inspection of munition quality could be held to the set standard. As for quantity production this also could be obtained granted that the manufacturing department was tooled to perform each operation with the human element reduced to a minimum and with positive stops and machines which are kept up, combined with a perfect sequence of operations. The inspection must be organized so that the product of each machine is safeguarded thus preventing the possibility of a run of bad work.

In connection with the above Mr. Reynolds outlined the organization of his plant, as follows:

The superintendent of inspection has chief inspectors for each eight hours' shift, with their assistants controlling each floor or battery of operations. Gaging is performed at the back of machines, the work being conveyed by gravity to inspection bench. Care is taken in the allotment of the quantity of machines for each inspector. All prime dimensions received 100 per cent inspection. Final shop inspection is not necessary with efficient machine inspection except to check parts which are liable to be affected at subsequent operations. All machine inspection is made with restricted tolerances, ensuring the acceptability of work by government with their larger limits. This method has proved most successful. The superintendent of inspection is responsible for quality of product to the general manager.

The superintendent of inspection is held solely responsible for the quality as the shop superintendent is for production, all differences being settled by the general manager.

Each inspector is provided with a small personal stamp which he or she stamps on a location allotted by the government inspector and which does not interfere with the product. By this means any faulty inspection is traced. The assistant inspector checks up his inspectors frequently. Given limit gages which are right, inspectors have no excuse to wrongly gage. All gages are checked daily and twice daily, where necessary, by the gage and standard department, who are held responsible for a sufficient supply of gages and their accuracy. The head of this department is the chief draftsman and he reports direct to the general manager. This complete system of inspection has proved very satisfactory in meeting the conditions which exist in the plant.

The writer thought that interchangeability applied to a machine or a mechanism was the attainment of producing standard units of mechanism which guarantee without selection the assembly of the machine. To illustrate, a projectile and its component parts are designed with limits which allow of shell fuse and cartridge case to assemble without selection. It therefore seems correct to assume that it is practical to maintain interchangeability in munitions without sacrificing the quantity of production.

R. F. Bryant[2] contributed a written discussion, which will be published in full in the next issue, covering the experiences of the Yale & Towne Manufacturing Company regarding several important phases of inspection, particularly of fuses.

[1] Supt. of Inspection, Lymburner Limited, Montreal, Canada.

[2] Supt. of Productive Efficiency, Yale & Towne Mfg. Co., Stamford, Conn.

# PUBLIC MEETING OF GAGE COMMITTEE

## Culminating in a Proposal to Government to Cooperate in Munitions Contracts by Requiring Certification of Gages by Bureau of Standards

REPRESENTATIVES of important Government departments, both Army and Navy, the British Ministry of Munitions of War in the United States, the Canadian Munitions Board, leading munitions manufacturers and makers of gages, met at the call of the Joint Committee on Gages of The American Society of Mechanical Engineers and the Society of Automotive Engineers on Tuesday afternoon, December 4, not for a technical discussion, but to consider in a broad, patriotic way what could be done to accelerate the manufacture of munitions and to provide means by which all munitions, wherever manufactured, should be interchangeable. Costly blunders in the handling of the gage question by this country during the Civil War and by foreign countries during the present war were responsible for serious delays and loss of effectiveness.

The Chairman of the joint committee, Harry E. Harris, President of the H. E. Harris Engineering Company, presided at the hearing, and called upon Major L. A. Fischer, in charge of the Gage Design Section of the Ordnance Department, to state the purposes of the meeting by reading a brief résumé of the work of the committee up to this time.

### INCEPTION OF SOCIETY'S GAGE WORK

This phase of the Society's war work had its inception at the Spring Meeting in Cincinnati last May. So clearly was the vast importance of this matter brought out by extended discussion that a resolution was adopted calling upon the Council to appoint a committee to cooperate with the Government in laying down a sound foundation for the tremendous munitions-manufacturing program upon which the country was about to engage. Representatives of the Society sent to Washington at the time, however, found that immediate action would be premature, but two months later conditions were considered sufficiently favorable and a committee was appointed. At a meeting on August 23, the committee agreed that there should be one central bureau for the certification of gages, and that the best place for such work was the Bureau of Standards at Washington. The inspection of all master gages should be made at the Bureau of Standards, but, if possible, some of the working and inspection gages be tested in the vicinity of the factories making munitions, or at the plants of the gage manufacturers. This meeting was followed by visits of the members of the committee to such department officials of the Government as were particularly affected by and interested in the question of gages. In general, these officials expressed their entire approbation of the plans of the committee.

### SOCIETY AND GOVERNMENT OFFICIALS GET TOGETHER

In order to get a concerted understanding in the matter, the

Society gave an informal dinner to a number of high Government officials and members of the Council of National Defense, following which those present joined in a general discussion of gage certification and standardization, displaying considerable unity of opinion and appreciation of the work the Society was endeavoring to do. While many phases of standardization were considered, especially as applying to raw material, manufactured products, and gages, the discussion centered around the absolute necessity of having all gages made to the same standards, to insure correct standards and interchangeability.

Following the dinner, a letter was sent to all present asking that each department concerned appoint a member of its staff with whom the committee might confer in working out a satisfactory program. This letter was well responded to by the various branches of the service. As a result, the committee now has serving with it official representatives of the principal departments concerned. The cooperation of the Society of Automotive Engineers has been secured in the form of a committee to serve jointly with our committee. All are agreed that standards of measurement, master gages, reference gages, inspection gages and Government inspection gages should be certified at the Bureau of Standards so far as is physically possible.

At a meeting in Washington, on October 30, it was ascertained, through correspondence and representatives of Government departments present, that many of the departments were conforming to the recommendations of the committee in having gages certified at the Bureau of Standards, that there was close cooperation in many instances, but not according to any universally accepted plan. It was recommended that the various bureaus recognize officially the Bureau of Standards as the technical source for the certification of all master gages, and as many of the inspection and working gages as possible. A subcommittee was appointed to prepare a clause for the consideration of the full committee, which could be incorporated in all Government orders for gages, and in contracts for war supplies in the manufacture of which the supplier would be required to make or purchase gages. Such a clause was submitted to the joint committee on November 10, and has been the subject of much discussion and correspondence. All comments and suggestions were considered at a meeting on Tuesday morning, December 4, and a final form adopted for submission to the Government departments if approved by this public meeting.

### Gages Must Be Checked Against Standards Under Unified Supervision

Chairman Harris stated, in further explanation of the work of the committee, that while a proper handling of the gage situation was of the utmost importance at the moment in securing certain supplies, such as airplane motors, truck engines, guns, small arms, ammunition, etc., the committee had no intention of proposing that on other material, such as fire buckets, for example, orders and specifications should require the sending of the gages to the Bureau of Standards. In order to produce war supplies of a mechanical nature on a large scale, in widely distributed plants, that will be correct to specifications, interchangeable and function properly, it is an established fact that universally correct gages must be had, and that the only way to have them uniform is to check them against the standard of measurement under unified supervision. Hence the recommendation that all gages be made to the standards of the National Bureau of Standards. This involves no change from existing standards, but insures the correct duplication of existing standards under the direction of technical experts equipped with instruments of precision such as few factories possess. Referring all gages to this central agency for verification would also prevent duplication of measuring equipment and technical staff, thereby conserving our most valuable resource, skilled man power. In conclusion, Mr. Harris called upon all present to unite in the single purpose of assisting the Government, setting aside private interests, desire for profit, prejudice and selfish pride, remembering that the recommendations made by these two great engineering societies, representing the vital forces of mechanical engineering in this country, would command the support of manufacturers, Government officials, the general public, and receive considerable attention from Congress.

### Important Gages To Be Certified by Bureau of Standards

The Chairman then called upon Mr. William A. Viall, Secretary of the Browne & Sharpe Mfg. Co., to read the clause proposed by the committee, which in its final form is as follows:

> The master and reference gages and standards of measurements, with which are to be compared the gages and measuring instruments used in carrying out this contract, are to be certified by the Bureau of Standards of the Department of Commerce, Washington, D. C.

The committee also proposed the following form of memorandum to be used by heads of various Government departments in notifying the branches and officers under their jurisdiction of the adoption of the Bureau of Standards as the official agency for gage certification:

> The Bureau of ———— designates the Bureau of Standards of the Department of Commerce, Washington, D. C., as the place at which all master and reference gages and standards of measurements are to be certified. This is intended to include all such master and reference gages and standards of measurement as are used by the ———— for the work coming under the cognizance of the Bureau, both in manufacturing and inspecting.
>
> All master and reference gages and standards of measurement used by private manufacturers in carrying out contracts for the Bureau, where certification is called for by the contract, shall be certified by the Bureau of Standards.

As pointed out by Mr. Viall, this memorandum does not call for the certification of unimportant gages. Each bureau prepares its own contracts, and thus has complete control of the extent to which certification shall be required. The master gage, in the mind of the committee, is the one gage or set of gages used as the ultimate reference in a factory on a certain piece of work. The reference gages are the gages distributed throughout the plant with which the working gages are to be compared from time to time. The reference gages are subject to wear, relatively small but possibly appreciable, while the master gages are not subject to wear during the life of the contract. If every gage could go through the Bureau of Standards it would be desirable, but since this is not a physical possibility, the committee has included in its recommendation

only the master and reference gages. Regarding the objection that this method of certification divides the responsibility for the correctness of the finished product between the Government and the manufacturer, the committee does not regard the proposed plan as any sharing of responsibility whatever. The Government furnishes the standard and the manufacturer must work to it.

### Meeting Opened to Discussion

The Chairman then declared the meeting open to all present, and called upon a number of those present to lead the discussion. Naval Constructor S. M. Henry heartily endorsed the proposals of the committee, and stated that they met the views of the Bureau of Construction and Repair.

Major L. A. Fischer, in charge of the Gage Design Section of the Ordnance Department, announced that the plan, practically as proposed, had been in operation for some time by the Ordnance Department on contracts for munitions which call for the manufacturer to supply inspection gages. The Government furnishes a set of master gages to the manufacturer and to the Government inspectors. These are kept at the factory and all inspection gages referred to them.

That there would be no delay in submitting gages to the Bureau of Standards, and had been none up to this time, was brought out by Major Fischer, who organized the gage-inspection service of the Bureau during the time when he was in charge of the division of Weights and Measures. Based on the experience of our allies, the gage-inspection division has been organized on generous lines.

Major Henry W. Torney, Inspection Department, Equipment Division, Signal Corps, said that his department had already made considerable use of the Bureau of Standards for gage certification, and expected to continue doing so.

### Experiences of Our Allies

An international note was added to the meeting by the presence of a representative of the British Ministry of War in the United States, Mr. H. J. Bingham-Powell, Inspector of Gages and Standards, who emphasized the importance of advising gage makers in advance what they would have to meet in the inspection of their product, and the importance to gage makers of having facilities for knowing that their product is correct. He extended a cordial invitation to all present to inspect the facilities of the British Ministry for the certification of gages.

The experience of Canada was outlined by Capt. Richard J. Durley, of the Imperial Munitions Board. At one time the Canadian troops in France were being sorely pressed through lack of sufficient ammunition, and it was necessary to speed up the manufacture of a certain fuse. Upon studying the situation, it became evident that the date on which a supply of fuses could be obtained was entirely dependent upon the dates at which inspection gages could be had. This has been the case also on most other work. Every day which passes without a sufficient supply of inspection gages means another day on which there will be no product. The present practice in Canada and in Great Britain is to have all gages pass through the Imperial Munitions Board and the National Physical Laboratory, respectively, for certification. They are then given a serial number, issued to the inspectors, examined at intervals and when worn down to the permissible limit are returned, reëxamined and scrapped.

In reply to a question from Major A. W. Erdman, Inspection Division, Ordnance Department, as to the meaning of certification as used in the proposed clause, Major Fischer stated that this was understood to be the certification by the Bureau of Standards that the gage was within the tolerances permitted to the manufacturer of the gage by the bureau in charge of the work on which it is to be used. Verification, on the other hand, means that the size of the gage is determined regardless of whether this size is proper for the intended use of the gage or not.

An interesting point brought out by Major Erdman was whether, in view of the fact that there are not available enough highly skilled gage makers to furnish the very large quantities of gages, especially thread gages, now required, it would be advisable to utilize a large number of less skilled men. This would no doubt result in less accurate gages, but if within the limits allowed the manufacturer who is to use the gages in producing munitions, it would simply result in reducing his manufacturing tolerance without affecting the quality of the product. This might involve difficulties in some cases, but many manufacturers would be able to get into production quicker and a great increase in the output of gages would be possible.

### Advantages to Manufacturers of New Plan

The advantage to manufacturers of gages of having their factory standards approved by the Bureau of Standards, or of having sub-stations at important points throughout the country, was brought out by Mr. Frank O. Hoagland, Assistant Works Manager of Pratt & Whitney. Where a gage maker has an order for a set of duplicate gages, subject to certification, he cannot make up more than one set until the first has been approved unless his standards have been approved. The first having been approved, it is readily possible to duplicate it and to check it. All purposes would therefore be served if only the first gage were sent to Washington for certification and the duplicates passed upon at a sub-station more accessible to the place of manufacture.

Then followed an exceedingly interesting discussion of numerous phases of the gage question, participated in by men of large experience on such matters with the Government, gage makers and munition manufacturers. Among the topics covered were the standardization of gages, the fixing of tolerances fair to the maker and user, means of securing greater production of gages and of regulating the flow of production, greater publicity in the technical press concerning the design, manufacture and use of gages, and other valuable suggestions now available for the use of the committee in the stenographic notes of the meeting. One hundred of America's leading men in this field freely contributed from their rich experience to the end that the industries of the country might make a prompt and satisfactory response to the call for enormous quantities of those mechanical products so essential to the successful prosecution of the war.

At the conclusion of the discussion, the contract clause and the accompanying memorandum prepared by the committee were approved by a unanimous vote of the meeting. The committee will now be able to present the matter in final form to the Government departments with the full approval of the two great engineering societies qualified to pass an authoritative opinion on this subject. There is every reason to believe that the suggestion will be promptly adopted and the committee will then be able to turn to other phases of its work.

# SOCIETY AFFAIRS

## A Record of the Current Activities of the Society, Its Members, Council, Committees, Sections and Student Branches; and an Account of Professional Affairs of Interest to the Membership

PRESIDENT TAFT said that the engineer, equally with the physician, was essential to the winning of the war. The Council of this Society, together with the boards of management of the other societies and the representatives of the engineering colleges, have persuaded the Secretary of War to make similar provision for engineering students who may be drafted to the provision made for students in medicine and dentistry who may be drafted; namely, that the students under the draft be reassigned to their respective colleges, to complete their technical courses. This is most impressive.

With the recognition by the nation of the opportunity for service goes the responsibility of rendering that service. The loyalty of the members of the Society and of the profession in general has never been questioned. The only unsatisfactory feature has been the inability of a large proportion of our members to find the opportunity for expression. Whereas approximately ten per cent of the membership is now in the service, several times this number would gladly join if they were only permitted.

I am happy to report the splendid progress of the Engineering Council, and the spirit of coöperation which is being developed between the engineering societies and the committees which have been engaged in war work. There seems to be every prospect now of having a joint committee at some time in the very near future.

The conspicuous service which the Society has been rendering is in its Engineering Resources Committee, whereby the Government or any industry or individual can obtain the names, addresses, and accomplishments of specialists of every variety. These the Society has been able to furnish to such an extent that over fifteen hundred members have been suggested for important service. A corps of experienced assistants loaned by this Society has undertaken now the classification of members of other societies who are coöperating in the movement. This is an activity which all members of the profession may report with considerable pride.

CALVIN W. RICE,
*Secretary.*

# THE NEW OFFICERS OF THE SOCIETY

ALL the officers listed on the ballot prepared by the Nominating Committee appointed by the President and consisting of L. E. Strothman, *Chairman*, Willis H. Carrier, Frederick W. Gay, A. M. Lockett and Paul B. Morgan, were elected at the opening session of the 38th Annual Meeting on Tuesday evening, December 4, 1917. The elections were: President, Charles T. Main; Vice-Presidents, Spencer Miller, Max Toltz and John Hunter; Managers, Fred A. Geier, D. R. Yarnall and Fred N. Bushnell; Treasurer, William H. Wiley. A brief biographical note of each of the new officers is given below.

## Charles Thomas Main

Charles Thomas Main was born in Marblehead, Mass., on February 16, 1856. He attended the public schools in that town and was graduated from the Massachusetts Institute of Technology with the degree of S.B. in the department of mechanical engineering.

He remained at the Institute as an assistant in the department of mechanical engineering for three years after graduation.

In the fall of 1879 he went to the Manchester Mills, Manchester, N. H., as draftsman. From there, on January 1, 1881, he went to Lawrence, Mass., as engineer for the Lower Pacific Mills. In March 1886 he was made assistant superintendent and in July 1887 superintendent of the mill, having in charge the engineering work also during the latter periods.

During this period of eleven years he had charge of the reorganization and the rebuilding of a large portion of the abovementioned plant, and for something over five years had charge of its operation.

About this time Mr. Main decided that he preferred to follow engineering rather than administrative work and resigned his office at the Pacific Mills. After one year in Providence, R. I., spent in engineering and mill work, he formed an association with Mr. F. W. Dean and conducted a business under the name of Dean & Main, devoted largely in the early days to textile, mill work, but gradually broadening so as to include other industrial plants. This association existed from January 1893 to January 1907, when it was dissolved. Since that time he has conducted an engineering business under the name Chas. T. Main.

During the period from 1893 to the present time a large number of industrial plants have been designed and constructed under his direction and many others reorganized. The steam engineering for industrial plants developing into steam-power-plant work, and the water-power work into hydroelectric developments.

Among the largest undertakings in the industrial plants are the Wood Worsted and Ayer Mills in Lawrence, Mass., and in the hydroelectric work four developments for the Montana Power Company, aggregating about 280,000 hp.

He has acted as consulting engineer on many projects and as expert witness or referee in many important cases and has placed valuations on many industrial plants for various purposes.

He was elected to membership in The American Society of Mechanical Engineers in 1885 and has been a manager for three years. He is also a member of the American Society of Civil Engineers, the American Institute of Consulting Engineers, the Boston Society of Civil Engineers (past-president), and of other technical societies; is president of the Engineers' Club in Boston, and is serving his second term as term member of the Corporation of the Massachusetts Institute of Technology.

He has written several papers on engineering subjects, some of which have been presented at meetings of the Society.

Mr. Main has been interested for many years in public

affairs and has served in several municipal offices for the purpose of advancing the idea of good government and doing his share of public work.

## Spencer Miller

Spencer Miller was born at Waukegan, Ill., April 25, 1859. He was graduated at the Worcester Polytechnic Institute in 1879, and after tutoring for a few months at Amherst College, entered the shops of the U. S. Wind Engine & Pump Co., of Batavia, Ill., where he remained for nearly a year. He then became a draftsman with the Link-Belt Machinery Co., Chicago, where he designed a number of rope drives, and a novel equipment for handling cargo by continuous systems of conveying for the Union Steamboat Company. He made important improvements in rope driving with grooved pulleys of different diameters by varying the angle of the grooves. This invention was the subject of a paper entitled A Problem in Continuous Rope Driving, presented by him before the American Society of Civil Engineers in 1897.

In 1886 he became associated with the Lidgerwood Manufacturing Co., of New York, which was then manufacturing a crude overhead cableway system involving fall-rope carriers of the chain-connected type, and he developed an entirely new fall-rope carrier system, which eventually resulted in obtaining a conveying speed of 2000 f.p.m. Mr. Miller continued the development of the cableway, added automatic dumping features so that loads could be dumped at the will of the engine operator, made towers self-propelling, traveling on tracks so that a great area could be covered, and adapted the cableways to the use of grab and scraper excavating buckets, so that today the cableways will convey single loads up to thirty tons over spans exceeding 2000 feet. The most noted installations were on the Panama Canal, where they were used for the construction of the locks. He developed the cableway as applied to the removal of logs from the swamp lands, reducing the cost of the logs at the mills 50 per cent, and adapted the log-skidding cableway for mountain work, skidding logs from the crests of the mountains, and out of gorges and ravines, enabling logs to be taken out of timberlands hitherto inaccessible by previous methods, one of the latest machines spanning 4200 feet.

Mr. Miller's latest adaptation of the cableway was on the Mississippi Levee Construction work. This machine is a straight-line cableway excavator, span 700 feet, operating a 3-yard drag scraper bucket.

One of the early problems of the Spanish-American War was presented to the Navy Department in the question of coaling ships at sea, and Mr. Miller designed a marine cableway that made it possible to transship coal under headway at sea. In coaling ships in harbor his method of broadside handling has increased the capacity from 25 to 150 tons per hour, and one man now does the work which under the old system required eighty. Many new colliers of the U. S. Navy, notably the *Jason*, *Orion* and *Neptune*, are equipped with this transfer system, for delivering coal to ships alongside in smooth water. In 1914 he made the refueling of warships at sea the subject of a paper read before the Society of Naval Architects and Marine Engineers. One of the most revolutionary devices invented by Mr. Miller is his breeches buoy cableway apparatus in use by the U. S. revenue cutter service, by which passengers can be rescued from any ship in the heaviest sea.

The greatest problem presented in these marine cableways was the maintenance of a constant tension in the supporting cable and also in the conveying cables, the surging of the ships tending to produce a variation of 600 per cent in the tension of the cables. Mr. Miller developed an engine which automatically maintained within 10 per cent a constant tension on these cables, compensating the varying strains produced by the wave motion affecting the ships. With this automatic-tension engine, Mr. Miller successfully solved the problem of bunkering fuel oil at sea, a supporting cable for the oil hose being held at constant tension by the engine.

His final development of this automatic-tension engine is for use as a towing engine. Its use eliminates the shock effect on the towing hawser and permits the use of lighter hawsers, of much shorter length, and limits the tension on the cable to a predetermined amount well within the safety limit of the cable, thus providing against excess strain.

In view of Mr. Miller's many activities in marine matters, it was natural that he was selected as a member of the U. S. Naval Consulting Board at its inception, and of which board he is now a member. He is chairman of The Fuel and Fuel Handling Committee, and also of the Life Saving Committee.

Aside from his engineering activities, Mr. Miller is greatly interested in civic and municipal improvement, especially in the establishment of public libraries, parks and playgrounds. He is a Vice-President of The American Society of Mechanical Engineers; member of the American Society of Civil Engineers, American Institute of Mining Engineers, Society of Naval Architects and Marine Engineers, and the Canadian Institute of Mining Engineers.

## Max Toltz

Max Toltz was born in Coeslin, Germany, in 1857, and was graduated from the Royal Polytechnic College of Berlin in 1878. He came to the United States in 1882 and became associated with the St. Paul, Minneapolis & Manitoba Railway, now the Great Northern, serving successively as draftsman, assistant engineer, bridge engineer and mechanical engineer. In the latter capacity he had charge for four years of the motive-power department.

From 1903 to 1905 he acted as consulting engineer of the Canadian Pacific Railway, during which time he built the Angus Shops near Montreal and also those at Winnipeg. He also acted as consulting engineer for the Erie Railroad during this period. In 1905 he became vice-president and general manager of the Manistee and Grand Rapids Railway, acting also as consulting engineer for different railroads at the same time. Since 1908 he has conducted a private practice, including the work of consulting engineer for the Great Northern Railway, the Northern Pacific Railway, the Chicago, Milwaukee & St. Paul and the Butte & Anaconda railways, reporting especially upon the electrification of steam roads, and also specializing in power plants, grain elevators and large handling plants, and iron-ore docks.

From 1900 to 1913 he was Captain of the Engineer Corps, Minnesota National Guard, and since 1913 Major of the Engineer Corps. He is now engaged in camp construction for the Government, his first camp having been Camp Robinson at Sparta, Wis. He is now at Camp Dodge, Des Moines, Iowa, where he has charge of the installation of the heating of the entire camp.

## John Hunter

John Hunter was born in Scotland in 1866, and was educated in public schools, serving his apprenticeship as a mechanical engineer before leaving Scotland.

The first twenty years of his career were spent in marine

service. In 1885 he joined the Red Star Line, *S. S. Westerland*, as junior engineer, sailing between Antwerp and New York, rising to first assistant of the *S. S. Friesland* of the same company in 1891. In 1895 he transferred to the new *S. S. St. Louis* of the American Line, running between New York and Southampton, as senior first assistant engineer, and at the outbreak of the Spanish-American War in 1898 was appointed chief engineer of the *S. S. St. Paul*, with the rank of Lieutenant, U. S. A.

The *St. Paul* was taken over by the United States Navy, equipped as an auxiliary cruiser and fitted out with twenty 5-inch guns, and under the command of Admiral Sigsbee saw much active service during the war which bore heavily on the crew. When the *St. Paul* went back in the North Atlantic service, Mr. Hunter continued as chief engineer until August 1905, when he gave up his naval career to enter consulting work.

During his twenty years of sea service he had traveled 1,500,000 sea miles, and had seen an interesting development in marine engineering. The steam pressure carried on boilers in his ships had risen from 10 to 200 lb., and the old low-pressure engines had given place first to the cross-compound type, with 80 lb. pressure, then to the triple-expansion three-cylinder engine with 165 lb., and finally to the six-cylinder quadruple expansion engines and twin screws of the *St. Paul*, with their 200 lb. pressure.

In August 1905 he went to St. Louis to take the position of chief engineer of the power plants of the Union Electric Light and Power Co. At that time the Ashley Street plant was under construction and changes were being made to increase the capacity of the station. In the early part of 1907 he was given charge of the construction work of the company and the completion of this plant, including the last section of the east river wall, where it was found necessary to sink two caissons to bed rock, 22 ft. below the zero stage of the river. He was also in charge of the steam-heating plant of the company.

He has recently been called into the service of the Government in the capacity of district manager for the Emergency Ship Building Corporation, with headquarters in New York City.

Mr. Hunter has been prominent in the affairs of national societies, having served for three years as a member of the Prime-Movers Committee of the National Electric Light Association. He served also as president of the Engineers' Club of St. Louis and for two years as president of the Caledonian Society.

## Frederick August Geier

Frederick August Geier was born in Cincinnati, Ohio, on June 23, 1866, and at the usual age entered the public schools, wherein he continued his studies until graduated from Woodward High School with the class of 1884. Two years later he engaged in the banking business in Newton, Kansas, but returning to his native city in September 1887, became connected with The Cincinnati Milling Machine Company as bookkeeper. He now owns a controlling interest in, and is president of, this company, which is generally acknowledged to be the largest plant in the world devoted exclusively to the manufacture of milling machines and accessories.

Some years ago, when The Cincinnati Milling Machine Co.'s business had grown beyond the capacity of the old plant (located on Spring Grove Avenue), Mr. Geier conceived the idea of organizing a factory colony grouped about a central power plant. Three other companies joined at once in the project, and the outcome of the idea is the present factory colony at Oakley, a suburb of Cincinnati.

The C. M. M. Co. now has one of the most modern plants in existence and employs about 2000 people. It provides ideal factory conditions as to light, heat, ventilation, and sanitation, maintains an employees' service and medical department, and provides space and equipment for a cafeteria, which is operated for the employees by a committee chosen by themselves. It also recently started a cooperative store for the benefit of its employees.

Mr. Geier is also president of The Factory Colony Co., The Modern Foundry Co., and the Factory Power Co., is a director of The Cincinnati Rubber Mfg. Co. and The Cincinnati Bickford Tool Co., also a director of the Lincoln National Bank of Cincinnati and also the Central Trust Co., Cincinnati. He is a director of the Ohio Mechanics Institute. He is at the present time also president of the Council of Social Agencies of Cincinnati. He is a member of the board of managers of the National Society for the Promotion of Industrial Education. For five years he served as trustee of the University of Cincinnati and chairman of its board. He served two years as president of the National Machine Tool Builders' Association, and served as chairman of the Cincinnati Section of The American Society of Mechanical Engineers for the term 1916-1917.

## D. Robert Yarnall

D. Robert Yarnall, member of the firm of Yarnall-Waring Co., and also vice-president and general manager of the Nelson Valve Co., Philadelphia, was born in Delaware County, Pennsylvania, in 1878. He was educated at the University of Pennsylvania, receiving the degree of Bachelor of Science in 1901, and that of Mechanical Engineer in 1905.

For a short time after graduation he was engaged in engineering work in connection with the design of cement plants, and for the five years just prior to 1906 he was superintendent of construction for Mr. Charles Edgerton, consulting engineer, Philadelphia. For the next four years his efforts were devoted to the interests of the Stokes & Smith Co., manufacturers of box-making machinery, during which time he assisted in installing the Taylor system of scientific management.

In 1910, Mr. Yarnall, with Mr. B. G. Waring, organized the Yarnall-Waring Co., manufacturers of power-plant devices, which company operates and manages the works of the Nelson Valve Co., of which Mr. Yarnall is also vice-president and general manager.

In 1911, Mr. Yarnall introduced into America the first V-notch weir meters for measuring rates of flow, and subsequently he invented a number of improvements on this device, including the now well-known heater-meter combination which is used extensively in power plants. He is the author of the paper entitled The V-Notch Weir Method of Measurement, presented before the Annual Meeting of the Society in 1912; and has just presented a paper before the Philadelphia Local Section, entitled Recent Developments in V-Notch Weir Measurement. He is also the inventor of a number of successful power-plant valves and other steam specialties.

He has taken an active part in the Engineers' Club of Philadelphia, being a member from April 18, 1903, and vice-president from February 1916 to date. During this period he was active in bringing about the broad plan of affiliation of the Engineers' Club with the local sections of national societies, the plan of affiliation now being familiarly referred to by other cities as the "Philadelphia Plan."

He entered the Society as a Junior in 1903, and was elected to full membership in 1911. Mr. Yarnall has been a member of the Society's Committee on Sections since its formation, and during the past year has been chairman of this committee.

He is a member of the Engineers' Club of Philadelphia, The University Club and The Franklin Institute.

## Fred N. Bushnell

Fred N. Bushnell was born in Saybrook, Conn., in 1867. He received a high-school education, and in 1883 moved to Providence, R. I., entering the works of the Providence Steam Engine Company, where he acquired his shop experience. His early education was supplemented by a special course of study in engineering subjects under private instruction, and he entered the drafting room of the Providence Steam Engine Company in 1885, where for several years he was engaged in designing engines, boilers, bolt-forging machines and other miscellaneous products of this company.

In 1889 he entered the employ of Robert Wetherill & Co., of Chester, Pa., returning to the Providence Steam Engine Company in 1890 as superintendent.

The mechanical equipment of many of the early electric power stations was built and installed under Mr. Bushnell's supervision. The rapid development of the electrical industry impressed Mr. Bushnell as offering unusual opportunities for young men with engineering training, and he decided to give up manufacturing and to devote his energies to electric-power-station work.

In 1893 he accepted a position as chief engineer of the Narragansett Electric Lighting Company, of Providence, R. I. In 1902 he was appointed chief engineer of the Rhode Island Company, which controlled the electric railways in Providence, Pawtucket and other towns in that vicinity.

He occupied these positions until 1907, when he entered the employ of the Stone & Webster Engineering Corporation of Boston, and was given charge of extensive power-station work for the Boston Elevated Railway Company. After this he was engaged for some time in making special investigations and reports on engineering projects, and in 1909 was appointed engineering manager of the Stone & Webster Engineering Corporation, in charge of all engineering work in its Boston office. In 1912 he was appointed vice-president and engineering manager.

Some of the recent works with which Mr. Bushnell has been identified are the alternating-current power system of the Boston Elevated Railway Company, comprising a large generating system, sub-stations and underground transmission; the power station of the Republic Railway & Light Company near Youngstown, Ohio, and the new River Station of the Buffalo General Electric Company, Buffalo, N. Y.

Mr. Bushnell became a member of the Society in 1891.

## William H. Wiley

William H. Wiley was born on July 10, 1842, in New York City, and received his A. B. degree from the College of the City of New York in 1861, and the degree of C. E. from Rensselaer Polytechnic Institute in 1866. He also studied as a special student at the Columbia School of Mines in 1868.

At the outbreak of the Civil War, in 1861, he joined the 7th Regiment, New York State Militia. In March, 1862, he was enrolled as First Lieutenant in the Independent Battalion, New York State Volunteers, mustered into the service, and served under General McClellan. When the regiment was mustered out in 1864, he was given the title of Major, U. S. Volunteers, for services under General Gillmore, on Morris Island, S. C.

Since 1876 Major Wiley has been a publisher of scientific works. He served as a member of the 58th, 59th and 61st Congresses from New Jersey. In 1897 he was president of the International Jury of the Brussels Exposition, and was a member of the Superior Jury, Brussels. He was a commissioner from New Jersey at the St. Louis Exposition in 1904.

Major Wiley is the author of a book on Yosemite, Alaska and Yellowstone, published in 1888, and has acted as New York correspondent for London *Engineering*. He is a member of the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the American Association for the Advancement of Science, the National Geographic Society, the Order of Leopold, Belgium, and the Loyal Legion.

Major Wiley has been a member of the Society since its organization. He was appointed on the Finance Committee in 1882. While serving as Chairman of this Committee he was elected Treasurer of the Society, in 1884, and has been regularly nominated and elected for the period of thirty-three years which has since elapsed.

# COUNCIL NOTES

NOVEMBER 16, 1917

A MEETING of the Council was held on the afternoon of Friday, November 16, 1917,[1] in the rooms of the Western Society of Engineers, Monadnock Block, Chicago. The following members were present: Ira N. Hollis, *President*, Max Toltz, A. M. Greene, Jr., D. S. Jacobus, Charles T. Main, W. F. M. Goss, John A. Stevens, C. H. Bierbaum, R. H. Fernald, William B. Jackson, F. R. Low, *Chairman of Publication Committee*, Charles Russ Richards, representing the *Sections Committee*, Alex. D. Bailey, Arthur L. Rice, George R. Brandon and Philip N. Engel, officers of the Chicago Section of the Society, attending the meeting by invitation, and Calvin W. Rice, *Secretary*.

[1] The November meeting took place after the December JOURNAL went to press.

The Council was welcomed by Mr. D. W. Roper, vice-president of the Western Society of Engineers.

*Anglo-American Conference.* It was voted to authorize the Executive Committee to accept the invitation of the Aircraft Production Board to the London conference, and to authorize the President to appoint a delegate.

*A.S.M.E. Boiler Code.* The Boiler Code Committee submitted a Revision of the Code which was received and ordered printed in THE JOURNAL. This was published in the December issue.

*Gas-Power Committee.* It was resolved that the existing committee be discharged, with thanks for their services, and a new Gas-Power Sub-Committee was appointed, as follows: C. H. Benjamin, *Chairman*, Harte Cooke, E. J. Kane, W. T. Magruder, H. R. Setz, H. F. Smith, J. H. Spitzglass, W. V. Stout, and D. McCall White.

*Committee on Technical Schools.* A committee of W. F. M. Goss, *Chairman*, A. M. Greene, Jr., and D. S. Jacobus was appointed to formulate for presentation to the Council at its next meeting a statement of the policy which in the opinion of the committee should be observed with reference to the maintenance of the activities of the technical schools as an agency for promoting efficiency in war.

*Western Society of Engineers and Chicago Section.* It was resolved that the Council extend a vote of thanks to the Western Society of Engineers for the use of their rooms and also to the Chicago Section for their hospitality.

Adjournment was taken to meet in New York on December 4, 1917, at the Annual Meeting.

### DECEMBER 4, 1917

At the meeting of the Council on December 4, 1917, preceding the 38th Annual Meeting, the following members were present: President Ira N. Hollis presiding, John H. Barr, C. H. Benjamin, R. M. Dixon, *Chairman of Finance Committee*, R. H. Fernald, W. F. M. Goss, Arthur M. Greene, Jr., W. B. Jackson, D. S. Jacobus, Julian Kennedy, F. R. Low, *Chairman of Publication Committee*, C. T. Main, Spencer Miller, H. de B. Parsons, C. T. Plunkett, Max Toltz, William H. Wiley, *Treasurer*, Past-Presidents John A. Brashear, James Hartness, Robert W. Hunt, F. R. Hutton, Jesse M. Smith, Ambrose Swasey, Worcester R. Warner, S. T. Wellman, by invitation, Dr. C. R. Mann, of the Carnegie Foundation, and Professor Gardner C. Anthony, of Tufts College, and Calvin W. Rice, *Secretary*.

*Coal Conservation.* President Hollis gave a resume of the matters leading to the request from Fuel Administrator Garfield for cooperation in the matter of coal conservation, and announced that the following appointments had been made: As consulting engineers to the Bureau of Mines, Charles L. Edgar, L. P. Breckenridge, R. H. Fernald, and Charles Russ Richards; for the U. S. Chamber of Commerce Fuel Committee, the request being made that Dr. Ira N. Hollis, President, serve as one of the members, the President appointed in addition: J. W. Lieb, L. P. Breckenridge and F. H. Clark.

*Aircraft Standardization.* In response to the invitation from the Aircraft Standardization Board, James Hartness, Past-President, was appointed the representative of the Society to the joint conference shortly to be called in London on the matter of standardization of aircraft production.

*Boiler Code Interpretations.* Interpretations covering Cases Nos. 177-180 were approved with slight changes and ordered published in THE JOURNAL.

The Council expressed its appreciation of the magnificent offer of Dr. Brashear to secure for the Library the works of Professor Langley, and ordered this offer communicated to the Library Board for appropriate action.

The thanks of the Council were returned to the retiring President, Dr. Hollis, for his uniform courtesy and untiring interest and efficient direction of the work of the Society during the past year.

Adjournment was taken to meet on Friday, December 7, as the Council for the year 1918.

### DECEMBER 7, 1917

The first meeting of the Council for the year 1917-18 was held Friday, December 7, on adjournment of the Annual Meeting. There were present C. H. Benjamin, A. M. Greene, Jr., F. A. Geier, W. F. M. Goss, John Hunter, R. H. Fernald, Ira N. Hollis, F. R. Hutton, W. B. Jackson, D. S. Jacobus, C. T. Main, *President*, H. de B. Parsons, D. R. Yarnall, Wm. H. Wiley, *Treasurer*, by invitation, H. A. Harris, Chairman of the Gage Committee, and Calvin W. Rice, *Secretary*.

*The Technical Schools in War.* Dr. W. F. M. Goss, Chairman, presented a revised report of his committee on the subject of technical schools in the war, and resolutions passed by the Engineering Council and the Society for the Promotion of Engineering Education were also read.

It was then voted that:

1. The Council of The American Society of Mechanical Engineers recognizes the serious responsibility of the engineer in the prosecution of the war, not only in the corps of engineers, but in the many other branches of the national service where highly trained engineers are required. It urges the importance, as a war measure, of utilizing to the fullest the present engineering ability, and of maintaining unimpaired the engineering strength of the nation for the successful prosecution of military operations, and for the support of the sustaining industries.

2. To this end the Council of The American Society of Mechanical Engineers points out the necessity for establishing an agency for coördinating the military needs for technically trained men, the available supply of such men, and the sources of training. It urges that schools of engineering as the principal sources of this training be regarded as closely allied in the national purpose with the Military and Naval Schools of the nation, and that in the further administration of the draft the attitude of the Government toward them be such as to maintain the efficiency of these schools.

3. The plea for attention which is herein urged is not made in the interest of schools or of students, but is made solely for the full utilization of existing engineering resources and the preservation of a source of supply of engineers.

It was resolved that copies of these resolutions be sent to the Secretary of War and to the Provost Marshal General, that the Council earnestly support and approve the resolutions of December 6, passed by the Engineering Council, and that such endorsement be included in the communication sent to the Secretary of War and to the Provost Marshal General.

*Sections.* On recommendation of the Committee on Sections, it was voted to approve the following appointments on local committees:

*Cincinnati:* George Galbraith, *Chairman*, Henry Ritter, *Vice-Chairman*, J. T. Faig, *Secretary*, E. A. Muller and A. J. Baker.

*Connecticut:* C. K. Decherd, *Secretary-Treasurer*.

*Buffalo:* F. E. Cardullo, *Chairman*, W. A. James, *Vice-Chairman*, E. B. Neil, *Secretary*, J. W. Gilmey, *Treasurer*.

*Student Branches.* On the recommendation of the Committee on Student Branches, it was voted to approve the establishment of a Student Branch at Tufts College.

*Dues of Men in Military Service.* It was voted that the procedure under B 16 (*b*), suspending the dues of members in active service, be as follows: In each case the Secretary shall require a written application from the member or a request in person or by representative, stating the facts of his service. Second, the Secretary shall refer each application to the Membership Committee with a request that the Committee report to the Council, after considering the facts in each case, the names of those members whose dues, in the opinion of the Committee, should be remitted.

*Power Test Committee.* In response to the request of the members attending the public hearing on the Power Test Codes at the Annual Meeting, the President appointed three members of the Society as its representatives on a Sub-Committee on Water Wheel Code, to act in conference with the appointees from the National Electric Light Association, the

American Institute of Electrical Engineers, and the American Society of Civil Engineers.

*Boiler Code Committee.* E. R. Fish and F. R. Low were appointed on the Committee.

*Further Appointments.* It was voted that Ambrose Swasey be appointed to succeed himself for a term of four years as a representative on the Board of Award of the John Fritz Medal.

W. F. M. Goss was appointed to succeed himself for a term of one year as the representative appointed by this Council to the Engineering Foundation Board.

R. M. Dixon was elected Trustee of the United Engineering Society to serve for a term of three years, to fill the vacancy caused by the expiration of the term for which John R. Freeman was elected.

Charles Whiting Baker was appointed to succeed himself for a term of three years to represent the Society on the Engineering Council.

George J. Foran was also appointed to represent the Society on the Engineering Council to fill the unexpired term of John H. Barr, who asked that his resignation be accepted due to the demands of Government work in which he is engaged.

*Executive Committee.* Chas T. Main, *Chairman*, Ira N. Hollis, D. S. Jacobus, Arthur M. Greene, Jr., Spencer Miller and John Hunter were appointed an Executive Committee of the Council under the provisions of B 26.

Adjournment was taken to meet in New York on Friday, January 18, 1918.

CALVIN W. RICE,
*Secretary.*

# WELCOME TO CIVIL ENGINEERS

IN the Auditorium of the Engineering Societies Building on the evening of Friday, December 7, the American Institute of Mining Engineers, The American Society of Mechanical Engineers and the American Institute of Electrical Engineers, the three original Founder Societies, joined in a formal welcome to the American Society of Civil Engineers, the fourth Founder Society, which has recently removed from its former home on 57th Street, New York, to new quarters in the Engineering Societies Building.

Mr. Charles F. Rand, President of the United Engineering Society, presided. He said that the coming of the Civil Engineers rounded out a plan made by wise men some fifteen years ago. The association of the four national engineering societies was born of a very general desire to secure the full advantages which come from complete coöperation. These advantages had been realized in many previous examples, such as the John Fritz Medal Board of Award, the Engineering Foundation, the backing furnished by the four societies for the International Engineering Congress and the Joint Committee of Engineering Societies which preceded the Engineering Council.

He said the societies' obligation to Mr. Andrew Carnegie for his gift of over one million dollars used in the construction of the Engineering Societies Building should never be forgotten. He sometimes thought that the signing of a check for that sum may not have been very difficult for Mr. Carnegie, but he was able to certify that the provision of the remaining amount, through the efforts of the Founder Societies and their members, was surrounded by some difficulty, although now fully accomplished. The property of the Founder Societies, including the real estate, the Library, the reserve and endowment funds, exceeding two and one-quarter million dollars, all free and clear.

He referred to the administration of the United Engineering Society, which occupies the unique position of standing not over but under the Founder Societies, having been formed by them to perform certain specific acts governed by contracts. The Engineering Foundation, which has an endowment fund for research, the Engineering Council and the great Library under the care of the Library Board, are all administered as departments of the United Engineering Society.

If the administration of the United Engineering Society has been satisfactory it is because its officers have followed the footsteps of a former leader who shaped its policies and guided the Society for a number of years. He referred to Mr. Gano Dunn.

### WELCOME OF ELECTRICAL ENGINEERS

Mr. Gano Dunn, selected to express the welcome of the youngest Founder Society, the American Institute of Electrical Engineers, to the oldest, the original engineers, said that his welcome was all the more agreeable because it was made in a moment of enthusiasm and in the inspiring presence of all the other societies.

He thought that the occasion would mark the most eventful day so far in the history of the engineering profession in America, for on it had come to all the accession of the American Society of Civil Engineers, with its prestige and leadership. We in turn, under the influence of that prestige and leadership, should ourselves contribute to the joint result each day more and greater things, so that from now on the dream of those in all the societies that have seen in the days ahead a great and united engineering profession, would come one step nearer realization.

### WELCOME OF MECHANICAL ENGINEERS

Dr. Ira N. Hollis, speaking for The American Society of Mechanical Engineers, said that the union of the Founder Societies had come at a time when every man's and every woman's heart is moved at the danger before our country. We could be nothing else but brothers whether we were together in this building or not; but we are now thrown so much nearer together that we can make ourselves more effective in the service of our country by being under the same roof.

He emphasized the responsibility of the engineer for the industrial order of the twentieth century, and pointed out that it is his task to help make the world safe for democracy even as his instrumentalities are now adding to the horror of the great war.

He welcomed the Civil Engineers as brothers and as companions in the work that we shall jointly give our country.

### WELCOME OF MINING ENGINEERS

Dr. Rossiter W. Raymond, representing the American Institute of Mining Engineers, said that it was with personal as well as with representative pleasure that he, in the name of the American Institute of Mining Engineers, resigned the title of senior of the Founder Societies to the great and famous organization of the American Society of Civil Engineers.

Dr. Raymond spoke in his happiest vein and showed how the Civil Engineers, plus the Mechanical Engineers, plus the Electrical Engineers, made the Mining Engineers, and the work of the Mining Engineers gave to each of the other branches its greatest opportunity for displaying its capacity.

Mr. William L. Saunders, Past-President of the American Institute of Mining Engineers, speaking "at large," as the Chairman put it, expressed the view that the occasion celebrated not merely a physical union but a spiritual uniting of forces for participation in civic affairs.

### Replies on Behalf of Civil Engineers

Mr. George H. Pegram, President of the American Society of Civil Engineers, responded on behalf of the new tenants. He averred that the Society moved to the joint house because service to our fellow-men, the interests of engineers and of the membership demanded it. The public, in his opinion, had not been informed on the work of the engineer, and not until it is so informed can engineers expect the recognition they deserve. In the closer cooperation of the four great societies he saw an opportunity for placing the engineer rightly before the public.

Dr. George F. Swain responded to the addresses of welcome on behalf of the members of the American Society of Civil Engineers resident outside of New York. It was his opinion that the society should have been in the union house before, and that it was there now in order that it might pull together with the other societies. In his opinion engineering organizations had heretofore confined themselves to two of four important purposes that they should forward. They had tried to advance engineering knowledge and to erect high standards for professional work and conduct. There remained now the work of making the engineer felt as a member of the community, and of working out plans by which the societies should do more for the individual member.

## Annual Meeting Smoker

The Smoker of The American Society of Mechanical Engineers, held on the evening of December 5, attempted a radical departure from the two held at previous annual meetings. It was felt necessary to plan for 800, and to provide for the maximum sociability and intercourse it was decided to dispense with chairs. Arrangements had been made for an illustrated talk on Japan by Past-President John R. Freeman, who in the year had visited that country, together with Past-Presidents Brashear and Swasey, and the Auditorium of the Engineering Societies Building was secured for this feature. This allowed for assembling the members and guests before conducting them to the assembly rooms on the fifth floor. The features of the latter part of the smoker, when the participants were required to remain on their feet, were unfurling of a service flag showing the then 433 of the membership in active service for the Government, an auction of eight posters of past-presidents, the secretary, the honorary secretary and the treasurer, and the serving of refreshments. A combination march and snake dance was provided for getting the 750 or more who participated from the auditorium to the fifth floor, and as members and guests filed into the fifth floor rooms they were given a special box containing cigars and cigarettes and a card inviting contributions for smokes for the engineer regiments abroad. Altogether, including the money obtained from auctioning the posters, $313.86 was raised for this purpose. The idea of providing a maximum opportunity for mixing by omitting the chairs appears to have been eminently successful.

W. W. Macon.

## Annual Meeting Excursions

Although conditions due to the war badly handicapped the Excursion Committee this year in arranging trips for the visiting members and guests at the Annual Meeting, yet four delightful trips were taken.

On Wednesday afternoon, December 5, a small party visited the Montgomery Ward Company's mail-order plant in Brooklyn and found much of interest there.

On Thursday afternoon a party of ladies took a sightseeing trip through downtown New York. Another party visited the Samuel L. Moore's Sons Corporation shipbuilding plant at Elizabethport, N. J.; this plant has been rebuilt and enlarged to take care of the increased demand for shipping and had ships in various stages of completion on the ways.

On Friday afternoon the Society was loaned the boat *Correction* by the New York Department of Correction for a trip around Manhattan Island. This trip was participated in by about 100 members and guests and was a most enjoyable occasion. Mr. Colwell's first-hand account of the trip is appended.

John H. Norris,
*Chairman Excursion Committee.*

### BOAT EXCURSION

An exceptional excursion around Manhattan Island and through the bridges was provided for the members and their guests at the Annual Meeting. As some of the party expressed it, the trip "showed New York by daylight, twilight and dark."

Through the courtesy of the Department of Correction of the City of New York, a large and comfortable boat was at the disposal of the Society for this interesting and well-attended trip. A congenial party, including quite a few college men and a bounteous supply of lunch, left the city dock, East 26th Street, about 1:30 p.m. The day was ideal.

After passing under all the bridges, fifteen in number, during daylight, the Hudson River was reached under a full red setting sun, a little larger and brighter than Dr. Brashear's; but the Doctor's was a close second.

The good boat *Correction*, with Captain Parkerson in command, steamed up the East River, passing under the Queensborough Bridge and through Hell Gate Rapids, and approached the new bridge and viaduct of the New York Connecting Railway slowly so that all had a fine view of that magnificent and massive engineering masterpiece. The Captain turned the boat around directly under the bridge which gave an opportunity to see the steel span directly overhead, then proceeded south and went through the upper part of Hell Gate, to the west arm, and was shortly blowing four long blasts for the Harlem River Bridge to open. The city flag, blue, white and yellow, at the bow of the *Correction*, was like a magic wand as the drawbridges, eleven in number, were swung open in turn—Washington Bridge and High Bridge allow clearance and were not opened.

At High Bridge, which is one of the most artistic bridges in the world, the tide was running strong and Captain Parkerson did some nice maneuvering to take his boat between the piers that support the arches, there being very little clearance.

Many points of interest were passed including Blackwell's, Ward's and Randall's Islands where many city institutions are located. Many large power and large manufacturing plants, the Speedway used exclusively for trotting horses, New York University with the imposing Hall of Fame and Library located on a prominent elevation, were all passed in turn. There were some shipyards "doing their bit," and last but not least the Ship Canal, which required skill to navigate a large boat like the *Correction* on account of the strong current and the crooked and narrow channel.

Going south on the Hudson River, the old familiar points were in view—Riverside Drive, Trinity Cemetery, 129th Street Viaduct, Grant's Tomb, the Soldiers' and Sailors' Monument as well as the Palisades and the large manufacturing plants on the Jersey shore, also some of our own and the Allies' grim fighters and cruisers in the river looking real business-like.

James V. V. Colwell.

# AMONG THE LOCAL SECTIONS

FOLLOWING the Business Meeting of the Society on Thursday morning, December 6, of the 38th Annual Meeting, there was held in the Auditorium of the Engineering Societies Building a "Sections Session," presided over by Mr. D. Robert Yarnall, Chairman of the Committee on Sections, and devoted to three-minute reports by those delegates from the Sections present. The reports, which are here published, were preceded by a statement from Mr. Yarnall of the accomplishments and aspirations of the Committee on Sections. As each delegate was making his report, a slide was thrown on the screen giving the history of the growth of his Section. Delegates were in attendance from Atlanta, Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Connecticut, Erie, Indianapolis, Milwaukee, Minnesota, New Orleans, New York, Philadelphia, Providence, St. Louis, San Francisco and Worcester.

## Foreword by Mr. Yarnall

FOUR signal events this year will go down in this history of the Sections as marked developments in this activity. First, the new By-Laws, after two years' study by the Committee as to the requirements of the Sections and with due regard for the suggestions and comments made at the Sections Conference in 1916, were approved by the Council and are now in effect. The By-Laws were developed with the idea of granting all possible autonomy to individual Sections, and hence merely supply a skeleton on which to build Section activities. These By-Laws were printed in THE JOURNAL in November 1916, and have been distributed to the Sections' officers as well.

Second, a session of the Annual Meeting was for the first time this year given over to the discussion of Sections problems, thus recognizing the prominent place the Sections movement has in Society affairs. Delegates to this meeting were officially appointed by the Sections and the expense to the meeting paid by the Society.

Third, a most important development of the year has been the establishment of the first State Section—the Connecticut Section, with its five Branches at Bridgeport, Hartford, Meriden, New Haven and Waterbury. The president of the Connecticut Section, Mr. H. B. Sargent, will report further concerning this interesting development. Our Sections Committee would insert here a word of caution that we do not encourage the formation of other State Sections until this new plan has been thoroughly tried out.

Fourth, is the innovation of holding meetings of the Committee on Sections in the various cities where Sections have been established. During the autumn, members of the committee have visited in turn Bridgeport, St. Louis, Milwaukee, Chicago, Detroit and Philadelphia. All of the members of the committee have been present at these meetings with the exception of Mr. E. H. Whitlock who is now a major in the Engineer Officers' Reserve Corps.

### SECTIONS' WORK MANIFOLD IN PHASES

The phases of the Sections' work are manifold. In each center in which Sections are established opportunities for service arise at every turn. The new Sections' By-Laws govern the activities of each Section only to the extent of insuring that its procedure is in conformity with the Constitution of the Society; they leave the Section free to carry out the details of its coöperative work with other societies' sections and with the local engineering organizations and the public.

In addition to the short three-minute reports that will be given today, at this Sections' Session, delegates have come into personal contact with the Council and have thus had an opportunity to familiarize themselves with the parent Society's attitude towards its Sections. At both the Annual and Spring Meetings this year, as for the past few years, the Section delegates lunched with the Council and Past-Presidents, thus affording an opportunity for the officers of the Society to become acquainted first-hand with the spirit of the Section movement. These luncheons also afford an opportunity for the new officers representing Local Sections to become acquainted with the friendly attitude of the Council towards this important movement.

In order that this session may give all present an opportunity to carry away an idea of what has been accomplished by the Sections Committee during the past year, we will summarize briefly its activities, as some of these matters will not come within the scope of the very interesting reports which will be made by those present on "the firing line."

### PROGRESS BY SECTIONS' COMMITTEE

Since the last Annual Meeting the Committee has held nine meetings to discuss the manifold problems which have confronted the twenty-two Sections. In addition there have been a number of meetings of the Sub-Committee on By-Laws for Sections, this work being largely performed by Messrs. Marburg and Rautenstrauch, who are entitled to much credit for the painstaking effort they have devoted to it.

During the year the establishment of the following Sections has been approved: Baltimore, Erie, Connecticut and Ontario, Canada. The latter is the first Section to be established outside the domain of the United States; its headquarters are at Toronto, and its territory embraces the larger portion of the Province of Ontario, from which it takes its name.

We have prepared a few charts (exhibiting slides here) to illustrate certain phases of Sections development. The first of these shows that meetings of the Society are already fairly well distributed over the country, and I might add that during the last year over 150 meetings have been held by these Sections. At practically every one of these points the A.S.M.E. Section coöperates closely with the local engineering society or club. It is felt that this spirit of coöperation in these localities is one of the strongest elements for good work for which the Sections are responsible and it is not improbable that through it the much-prophesied combination of the national engineering societies may be effected. But of course the last thought does not come within the scope of the Sections' work. We do, however, wish to urge all Sections to cultivate the fine spirit of coöperation which is already manifest at so many points.

In the last few years there has been a wonderful increase in the number of those enrolled as members of the Society. Whereas the Committee on Sections does not hold that it is responsible for this growth, it is noticeable that the Sections movement was started just two years prior to the upward trend of the membership curve. There is no doubt that widespread holding of meetings throughout the country will encourage those at distant points to come into the ranks.

### SECTIONS AND THE JOURNAL

The Sections Committee is desirous of having the Sections contribute their share to the upbuilding of THE JOURNAL through the development of high-grade papers and also to accept their share of responsibility for the much-needed development of research work as was discussed fully at the Sections Conference on Tuesday afternoon. With this aim it has recommended that the individual Sections appoint committees on papers and research. It is felt that a wealth of information is lying dormant and that this may be made available through two good live committees in each Section.

Thus far the Sections have not responded to these suggestions with as much alacrity as had been hoped. The fact that the British Government has recently appropriated fifteen million dollars for research work at a time when the very existence of the country is at stake shows how keen is the need for such work.

In this connection it is interesting to note that at two recent Sections' meetings the importance of industrial research has been emphasized: On October 18, at Cincinnati, Mr. F. O. Clements gave an interesting address on The Research Laboratory Applied to Industry, and again at Buffalo, on October 17, Doctor C. E. K. Mees, head of a well-known research laboratory, delivered a lecture before the Section on Scientific Research.

### OTHER GOOD SUGGESTIONS

Another suggestion for Section activities is the opportunity offered to the Sections through the valuable group of papers presented yesterday at the Keynote Session. We might assign one of these subjects to each of the two or three Sections in whose localities the respective operations are being carried on, i. e., take the shipbuilding problem for instance, the Sections at San Francisco, Boston and Philadelphia might make it the subject of a symposium on shipbuilding, somewhat similar to the symposium on forging suggested by Mr. White of Milwaukee on Tuesday. By proper apportionment of the list we believe the Sections might contribute real aid to our country at the present time.

Each Section executive committee should consider the possibilities for increasing the membership of the Society during the coming year. We suggest that Chicago, for instance, which has about 417 members, might reasonably aim to add 100 new members, or make an increase of about twenty-five per cent. Some Sections might even be more ambitious, but there is no doubt that such an activity could be conducted upon lines so dignified as to leave no question concerning the high standard of membership which at present exists. That the time is opportune for such an activity is evidenced by the fact that over 1700 applications for membership in the Society have been received since January 1, 1917. The mechanical engineer is the engineer of the industries, and the industries are doing their share in making the world safe for democracy.

President Hollis, during his term of office, has visited practically every Section of the Society and has done much to create enthusiasm for the Section movement all along the line. Our Committee feels under great obligation to him for his constructive suggestions and his timely counsel. In our journeys among the Sections we have felt the impress of the ideals of professional and national service, and engineering democracy, which he has driven home. We are very glad to have him with us today to tell you personally of his conception of our Sections and the opportunities which are theirs.

## Reports by Delegates

MR. POOLE (Atlanta): The influence of the Atlanta Section has accomplished a unique result. It has brought about the actual, practical recognition of engineering in municipal affairs. Of course, we know that all cities have their city engineering or equivalent departments. We also know that the city engineer or equivalent official is elected by popular vote, and therefore his department is honeycombed with politics, and that was true in Atlanta as elsewhere, but in Atlanta the influence of the Local Section of the A.S.M.E. has brought about the appointment of a non-political body known as the Board of Consulting Engineers for the City, composed of two civil engineers, one of whom is also a mechanical engineer, an electrical engineer, an architect, and a mechanical engineer pure and simple. The functions of this Board are purely advisory, but it has done some very unusual things. Disagreements between heads of the different departments on engineering matters, and on other outside interests, like the street railways, are all referred to the Board and its decision is final. That is an accomplishment we may be proud of.

Atlanta has also, due to the influence of the Local Section of the A.S.M.E., a mechanical-engineering department. I do not know of any other city in the United States which has that. The Department is non-political, the head of the Department is appointed by a non-political board, the members of which are prominent business men not connected with any of the big companies, but with engineering interests generally.

The Committee on papers has been promised three or four fairly good papers for the coming winter. Recently our Section has increased its membership from 30 to 35 per cent.

MR. VARNEY (Baltimore): The members of the Baltimore Section are affiliated with the Engineers' Club. Some forty are now in active service.

We have had one meeting this season. We generally endeavor to have at our meetings one technical paper and one popular talk, so as to make the latter intersting to our visitors. In the notices sent to the affiliated engineers in our Section, we enclose a printed card setting forth the objects of the Section, and stating why they should contribute papers and attend in person, and the assistance they could give by their presence and their advice to the younger men coming in. If we had a number of such cards we could follow up by a telephone call and a personal visit that would add greatly to the effectiveness of our work. We have difficulty in getting our members out. New industries are being rapidly established in the suburbs around the water front, and we are not acquainted with the engineers connected with these enterprises. It is necessary at first to send them an invitation to attend our meetings, and a typewritten letter, signed personally by the Chairman, is sent to these engineers. I think our Sections Committee should furnish letters of this kind. The officers of the Section have limited facilities for getting around to widely scattered plants.

A large percentage of our members are at Annapolis.

MR. KLINCK (Birmingham): The Birmingham Section took a very active part in the formation of the Alabama Technical Association, the membership of which is only open to members of national societies. It is our intention at an early date to have a joint meeting under the auspices of the A.S.M.E., covering the conservation question, particularly of fuel, etc.

The Committee on Papers has a definite promise of three papers, with favorable prospects of securing more.

We endeavor to increase our membership entirely by personally discussing the matter with those whom we think should be with us, by inviting them to the meetings and getting them interested, and the results we are obtaining indicate that this is the right procedure for our territory. In addition, at our last meeting each member present pledged himself to get at least one new member during the coming year.

Our aim in getting members is to secure those whose membership will be active and permanent. We have from thirty to forty per cent of our membership at the meetings.

MR. STARKWEATHER (Boston): The aim of the Boston Committee is: First, to make the Section meetings of maximum engineering interest and value to the local members; second, to promote acquaintance and mutual regard among them; third, to

safeguard the Society from commercialism and to prevent control by any interest or group of interests, and fourth, to have in constant training a considerable number of sub-committeemen, so that there shall be true succession in office of able men well fitted for the duties involved.

For carrying out these four aims we have endeavored to make the meetings successful by having addresses on the vital questions of the present times, given by men eminent in their lines and with direct recent experience. The engineering features of the great war are legitimate questions of this kind, and for our first meeting this year on Trench Fighting and Modern Land Warfare we were fortunate enough to secure Lieut. André Morize, of the French Army, detailed for instructing the Harvard Regiment. At this event, the French and American colors were displayed, and the guests were prominent army officers. The meeting was preceded by a buffet supper and from 175 to 200 were present.

For the second meeting on Aeroplane and Air Fighting, the same general plan was followed with Lieutenant-Colonel Rees, of the British Royal Flying Corps, for the speaker. We used the British and American colors in this case, and made an effort to give some formality to the affair. There were probably 225 present.

The third meeting on Shipbuilding was even more successful than the preceding two from a technical standpoint. Mr. E. H. Ewertz, General Superintendent of the new Destroyer plant now nearing completion at Squantum, near Boston, and Mr. H. G. Smith, Vice-President and General Manager of the Fore River Shipbuilding Company, made addresses which were enjoyable and instructive. President Hollis presided, and we were further honored by having President-elect Main as our guest.

In all of these meetings some effort has been made to plan in advance for the discussion, but usually there is no lack of it, the subjects being of special interest to every one. Usually we begin at 7.30 and adjourn before 10.30, the luncheon or dinner being at 6.15.

To meet the requirement for the extension of acquaintance, we have reached the conclusion that if members and guests on meeting nights come direct to dinner from their offices and plants, much time is saved, their attendance is secured, and the hour or two so spent promotes the object sought. We are endeavoring to cultivate more cordiality at these lunches and dinners, so that by the time cigars are lighted every one has been repaid for coming and all are ready for the meeting. Because the Section really stands for the Society to ninety-five per cent of the members, everything possible should be done to emphasize and strengthen its influence and activities, and the social side should not be neglected.

Coming now to the delicate question of internal politics, our belief is that the greatest good to the greatest number should be the aim, and even further than this, that the Society has a positive function to perform (but not a mission) in maintaining the strictest standards possible of the ethics of engineering, untainted by commercialism. As this is a direct reflex usually of the personality of each Executive Committee, we desire as representative and broad-gage members as can be secured. In these days of large readjustments and shifting of capital and labor, nationalizing of industries, mobilizing of effort, saving of resources, etc., the Society has the opportunity of its existence, if it will but seize it, and each Section must take advantage of its local opportunities.

The appointment of three sub-committees of three members each on Papers, Sociability and Membership, and Research gives nine men who assist the Executive Committee, and who are possible nominees for the ensuing year. In this way we avoid carrying over old members of the Executive Committee. All the sections should be run with the same system and careful planning as any business, avoiding one-man rule, and with an eye solely to the enlargement of the usefulness of the Society to the community and to its members. We make it a point to encourage suggestions and criticisms, and in every way to enlist coöperation, and these three sub-committees are in line with this intent. We also provide combination meetings with other societies, and have an annual banquet.

In conclusion, while we do not claim the solution of all the problems which have tried the skill and patience of our predecessors, we believe their experience has been of value by indicating, at last, various things to avoid, and we shall endeavor to hand over to our successors a Section somewhat improved because of our connection with it.

MR. CARDULLO (Buffalo): Some five or six years ago the Local Section of the A. S. M. E. in Buffalo got together and started the Buffalo Engineering Society. The Society has a membership of several hundred and is increasing very rapidly. It holds a meeting every week. The Local Sections of the various engineering societies are affiliated with it, and our activities are carried out through the medium of the Buffalo Engineering Society, each local section being responsible for certain meetings of the Society. The A. S. M. E. Section is responsible for four meetings a year and the other local sections for a similar number.

I find that the greatest difficulty in the work of our Local Section of the A. S. M. E. is in the fact that the Section shows a disposition to elect as officers the busy managers of the biggest corporations in Buffalo, and in this way the younger men are rather left out of the game, and I think we are missing a good deal from the fact that we have not put the younger fellows into the places where they can bear the burden of the day.

The Buffalo Engineering Society is doing more for us than we are doing for ourselves, but in a way we feel that we are responsible for that, and as loyal and earnest members of the Buffalo Engineering Society we are doing a great deal for the community.

MR. ENGLE (Chicago): We held four general meetings, as usual, in 1917. They were informal, and were attended by from 100 to 180.

Recently we have taken up the matter of coöperating with the Western Society of Engineers.

MR. LANGEN (Cincinnati): We are affiliated with the electrical engineers and also the civil engineers, and we jointly elect a chairman, this officer usually changing about between the electrical and mechanical engineers each year. We aim to have eight good interesting papers each year. We have done this for the last two years, and the attendance of the meetings has increased considerably. The Chairman and Executive Committee of the Board meet once a week for a luncheon. We have no Papers Committee as the Chairman and Secretary of the Section take care of this. We invite the older students of the University of Cincinnati to hear specially interesting papers. Our membership is increasing and we have enough applications to increase it to from 111 to 150 this year. Twelve of our men have gone into the army in the last sixty days.

MR. SARGENT (Connecticut): The Connecticut Section is so young it has not much of a record back of it, except the record of the New Haven Section, now classed as the New Haven Branch of the Connecticut Section. The Section as organized consists of branches in Bridgeport, Hartford, Meriden, New Haven and Waterbury. It has held only one formal meeting.

We have been very generous, as we think we should be, in inviting those who are interested to come in, whether they are members or not, and some of them become members or applicants for membership in the Society.

The organization of the Connecticut Section began with an endeavor on the part of the engineers in Meriden to have a little social intercourse and get acquainted, and that acquaintance ripened into a belief that the members ought to have some recognition on the part of the Society. We met and devised a skeleton plan which the Committee on Sections approved, and that resulted in a kind of automatic organization, whereby, there being five proposed branches, the several Chairmen of these Branches should constitute the Executive Committee of the Section, and under that scheme we are now running.

We met under the auspices of the New Haven Branch at our last meeting. We will hold other meetings in different parts of the State, either in New Haven, Hartford, Bridgeport, Waterbury or Meriden, and the meeting will then be under the auspices of that Branch. We are trying to work out our organization to make it a sort of home-rule government within certain limits.

MR. SHERWOOD (Erie): I want to speak first about having notices issued by the Sections sent to the Chairmen and Secretaries of other Sections, so that we may see what means are taken to induce the men to come to the Sections meetings in the

various parts of the country. I have so far received no notice of meetings by other Sections, and I am frank to say that I have deferred putting the names of other chairmen and secretaries on our list.

Our Section is less than a year old, and as a consequence, we are not very strong yet, but we are gaining strength through coöperating with the Society of Engineers of Northwestern Pennsylvania, and on that account we are having fairly good meetings. An effort to increase the membership will be made, as at the present time we have only about twenty-six members.

MR. WALLACE (Indianapolis): The keynote of the Indianapolis Section has been coöperation. We have coöperated with the Indiana Mechanical Society at its annual meeting, by having one department of the program on one day.

The Indianapolis Section has been instrumental in organizing the Indianapolis Engineers' Club, which is a clearing house for all of the engineers in the city. Through the Club we fostered and organized the first battalion of engineers in the state of Indiana that has gone into the service.

MR. WHITE (Milwaukee): We have about one hundred members. Our activities can best be illustrated by saying that we have appointed a committee of twelve to draw up papers for the city of Milwaukee, in which they select engineers for city service. We have arranged for a meeting this month at which we will have a symposium on forgings, six speakers, and a visit to the largest forging plant in operation west of Pittsburgh. We are also doing something in research.

MR. BRINK (Minnesota): Our Section has about one hundred members. I think it is a mistake to have a Section to take in a whole state, because it is hard to get the members together at our meetings, although we have meetings alternately at St. Paul and Minneapolis, and occasionally, once a year or so, we meet in Duluth. We are trying to perform social work and also work on interesting papers. The Section this year has set out to get the A. S. M. E. Boiler Code adopted in Minnesota.

MR. HUTSON (New Orleans): Practically all of our work is done in coöperation with the Louisiana Engineering Society. That Society is about twenty years old, and a very live one. When our Local Section was first organized, we and the local Section of the A. S. C. E. held joint meetings in the rooms of the Louisiana Engineering Society, so that for all practical purposes they were extra meetings of that Society. One of those meetings was very successfully held about the time this country entered the war, and as the result of a paper on Preparedness the Louisiana Engineering Society made a roster of the engineers in Louisiana, with an entry of their capabilities.

This year it was arranged that we will be responsible for one meeting in the spring and one meeting in the fall, under the auspices of the Louisiana Engineering Society. Immediately after that meeting we have our business meeting, so that our business affairs are separate from those of the Louisiana Engineering Society, but all of our technical affairs are consolidated with it.

MR. PRINDLE (New York): Our coöperation in New York with other scientific societies has consisted in our inviting the members of some particular society to meet with us at some of our meetings, where we had a paper which we thought was particularly interesting to the members of that Society, and such societies, on the other hand, have invited us to their meetings under like circumstances, and all have understood that the meetings of each society are open to the members of the other societies, but further than that we have not found it advisable to go as yet, because in New York the sections are so large the meetings become rather unwieldly where you combine two or more.

We have emphasized very much in the last year or two the get-together spirit, trying to break down the frigidity which exists in New York among people who do not know each other socially, and dinners and dinner dances and little buffet suppers just before the meetings have been used successfully.

MR. MUDD (Philadelphia): We have the coöperation and affiliation idea in Philadelphia very nearly the same as the other Sections we have heard from. All the Branches of the National Engineering Societies have headquarters in the Philadelphia Engineers' Club. Last summer we had to raise a large amount of money to enlarge our auditorium, and the members of the Society succeeded in raising $32,000.

We opened the year with a joint meeting with the Engineers' Club, and the subject was The War in Its Relation to Shipbuilding. We had about 600 present, and probably one-third of those represented the A. S. M. E. Several of our papers were published in THE JOURNAL last year, and arrangements have been started to publish three of them this year. The remainder of the papers will be published in the Journal of the Engineers' Club.

MR. BURLINGAME (Providence Engineering Society): Providence has a prosperous engineering society affiliated with the A.S.M.E. in a novel way. It was through the good offices of the A.S.M.E. that we enlarged our local society into a General Engineering Society which has now five or six hundred members, taking care of the general engineering interests in the neighborhood of Providence. That society is holding meetings under the leadership of a number of sections, eight sections hold meetings, so that we have about three meetings a week at our headquarters, besides the monthly meeting of the general engineering society. The local headquarters have been furnished by the liberality of a local member, who is also a member of the A.S.M.E., a lantern has been donated to us, and we have the nucleus of a very good library, so we feel especially indebted to the A.S.M.E. along all of these lines for the development and growth of our local work.

We have two local officers, a chairman and a secretary to each section, who divide the responsibility and give us a wide range of subjects. Our membership is increasing, and we feel that the society is a valuable factor in Providence in helping along the work of the Government. Many of our members are in the service, and others are working in connection with war committees on various kinds of work. I am a member of the New England Committee on the subject of intensified industrial training, the importance of which has been emphasized today.

MR. RADCLIFFE (St. Louis): The St. Louis Section has about one hundred members. We are holding regular monthly meetings of a social nature, always followed by a paper or an address on an engineering subject. We are affiliated with the Engineers' Club, in what is known as the Associated Engineering Societies, which is made up of the local chapters of the national societies, with a total membership of about five hundred, but we still maintain a very strong individual identity as a local Section of the A.S.M.E.

If the Sections are to be the backbone of the Society, the best way that the Society can stiffen that backbone is to send members of the Council around to visit the members of the Section and stimulate their interest in the Section work. Only two or three of the local Sections can get in touch with headquarters, and the next best thing is to bring headquarters in touch with the members of the Society in their various localities.

MR. DELANY (San Francisco): The San Francisco Section, formed in 1910, is one of the oldest Sections in the Society. We have had one good meeting this year, for which we have to thank President Hollis. We invited the other sections of the various Societies to join with us, and they were quite enthusiastic in their responses. The meeting was very successful, and several members of the other Societies complimented us afterwards on the holding of this joint meeting, and expressed the hope that the other societies would do the same thing later.

We have had a good deal of difficulty in securing papers. We started by trying to secure papers by correspondence, and since then we have appointed a Papers Committee, and we expect results from that committee's work. We also have appointed a Research Committee, and during the present week there was to be a meeting of our Executive Committee with both the Papers Committee and the Research Committee, to find out just what progress is being made.

MR. FAIRFIELD (Worcester): The Worcester Section of the A.S.M.E. was formed to establish a means for engineering acquaintance and coöperation between the local members of the Society and the non-members who are engaged in our industrial firms. We have also established very close relations with the alumni and students of our local engineering college, the Worcester Polytechnic Institute.

# Reports of Section Meetings

## ATLANTA

*November 6.* The first meeting of the current fiscal year was held at the Hotel Ansley. The members were entertained at supper by the new chairman, Oscar Elsas, Mem.Am.Soc.M.E., after which Professor J. S. Coon delivered an interesting address on the subject of Aviation with Relation to the War. Following this routine business matters were discussed and most encouraging opinions were expressed regarding the remainder of the season. It was decided to hold meetings monthly and to have presented at each meeting either a paper or an address on an appropriate subject.

CECIL P. POOLE,
*Section Secretary.*

## BOSTON

*November 13.* A dinner was held at the Engineers' Club, with President Hollis and President-Elect Charles T. Main, together with Mr. H. G. Smith, Vice-President and General Manager of the Fore River Shipbuilding Co., and Mr. E. H. Ewertz, General Superintendent of the Squantum Destroyer Plant of the Fore River Shipbuilding Co., as the guests of honor. After a short business session, Chairman Ashton turned the meeting over to President Hollis, who gave an entertaining and timely address, and then introduced Mr. Ewertz, who described the rapid building of the Squantum plant, which was an aviation field six weeks ago, but which is to deliver 35 submarine destroyers in sixteen months, beginning January 1, 1918. The plant is nearing completion at this time.

Mr. Smith delivered an address on the Recent Development of the American Marine Industry, approaching the subject not only from the engineering but from the production side, particularly with reference to the question of labor. He was later asked many questions as to various elements of the labor situation, and the discussion thus started, terminated in a very successful meeting.

W. G. STARKWEATHER,
*Section Secretary.*

## BUFFALO

*November 16.* At the second general meeting of the Engineering Society of Buffalo, and its affiliated sections, Dr. C. H. Norton, Mem.Am.Soc.M.E., gave a talk on the Modern Cylindrical Grinding Machine. Dr. Norton illustrated his lecture and cited many interesting points in the design of grinding machinery.

L. H. Hart, engineer for Lupfer & Remick, Civil Engineers, spoke on the subject of Electricity on the Barge Canal, at the November 21 meeting of the society. Mr. Hart pictured a barge canal electrically operated by a push-button type of boat, and predicted that these boats would be run on the canal eight months of the year. This canal would relieve railroads of bulk freight and give them greater opportunity for development in carrying other lines.

At a meeting of the Automotive Section of the society, on December 6, G. Douglass Wardrop, Editor of the *Aerial Age*, talked on Aeroplanes, Uncle Sam's Infant Industry. He illustrated his subject by numerous lantern slides and several reels of films. Quoting Mr. Wardrop:

"A wedge will soon be driven through the lines of the German armies, and I believe that the point of that wedge of liberty will be the aeroplane.

"Young men in Buffalo will have the satisfaction of knowing that on many of those planes the name of Buffalo will be stamped somewhere in their mechanism.

"The aeroplane is the greatest factor we have now for the advancement of civilization. It is the wedge-point of liberty. Buffalo is now the leading aviation center in this country. In a short time it will be the greatest single aviation center in the world. But you Buffalo people will have to work hard indeed if you want to keep that supremacy. Detroit has got the automobile industry practically to herself, and she is trying to do the same with aviation. Detroit now stands second, and is rapidly increasing her importance as a producing center for aeroplanes and their parts."

Among the interesting applications of the aeroplane Mr. Wardrop showed the picture of a Montana ranchman using an aeroplane to round up his cattle. He flies over his wide plains and drops a smoke bomb when he finds the straying herds. The cowboys note the fall of the bomb and hurry to the spot. He showed pictures of inaccessible mining districts, wealthy in resources beyond present computation, but lightly worked now because of the enormous cost of transportation, that could be reached in an hour by the use of aircraft.

The society held another meeting on December 12, at which F. A. Parkhurst, Mem.Am.Soc.M.E., spoke on The Mobilization of Labor. A fuller account of this meeting will be given in the following issue of THE JOURNAL.

LOUIS J. FOLEY,
*Assistant to Section Secretary.*

## CHICAGO

*November 16.* President Hollis and several members of the Council were present at the first meeting of the Section for the season. Dr. Hollis addressed the audience on the engineer's task in the present war. He said that the terrible effectiveness of modern warfare is due largely to inventions of the engineer, and it now lies with the engineering profession to say whether the results of its work shall be only to make war more horrible, or whether by its influence it shall be possible to make the present war the last one, and to determine that cooperation and the use of the engineering inventions shall be for the happiness of the people instead of their hurt. If increased efficiency of human effort is to mean simply an increase of population which will result in a greater struggle for dominion and greater effectiveness in killing, it is not worth having. Dr. Hollis spoke of the effectiveness which engineers may have in helping the officials who are charged with conservation or resources, by acting in consulting capacity on such matters as fuel conservation, and by acting as speakers to educate the public in the necessity for and the methods of preventing waste of food and fuel.

Major Peter Junkersfeld, Mem.Am.Soc.M.E., delivered the principal address of the evening on Cantonment Construction, giving much information and data in regard to his work in the cantonments. In his capacity as officer in charge of inspection, he had had exceptional opportunity to gather information and presented a most instructive paper, which will be published in full later.

Altogether the evening was a great success, the meeting being the most enthusiastic and best-attended since the inception of the Section.

ARTHUR L. RICE,
*Section Secretary.*

## ERIE

*November 13.* Pulverized Coal and its Future was the subject of an address by H. G. Barnhurst, Mem.Am.Soc.M.E., at a joint meeting of the Section with the Engineers' Society of Northwestern Pennsylvania. The meeting was opened by Mr. Schumm, President of the Engineers' Society of Northwestern Pennsylvania. The speaker of the evening gave a most interesting account of the developments in the use of pulverized coal as fuel.

M. E. SHERWOOD,
*Section Secretary.*

## INDIANAPOLIS

*November 7.* L. O. Armstrong, who is traveling under the auspices of the Bureau of Economics of the United States Government, gave an illustrated address. Mr. Armstrong is endeavoring to stimulate interest and enthusiasm for all efforts of the Government in carrying on the war. His talk was valuable, profitable and very much appreciated. His subject was Canada at War, and was well illustrated by motion pictures and lantern slides.

At the same meeting Captain Brown, of the Canadian Engineers, gave a short talk pertaining to his experiences in the trenches in France. Captain Brown is back in this country on a sick leave, and while here is the recruiting officer for the Canadian Government in the city of Indianapolis.

Captain Reeves, of the United States Army, also gave a very interesting talk concerning the qualifications required by young men for the aviation service. Captain Reeves is the local recruiting officer for the Aviation Section of the United States Army. He was for many years professor of economics at the University of Michigan at Ann Arbor.

L. W. WALLACE,
*Section Correspondent.*

### LOS ANGELES

*November 14.* The meeting of the Technical Societies of Los Angeles took the form of an automobile trip to the top of Mt. Wilson, the occasion being a visit to the Mt. Wilson Solar Observatory. The exciting part of the trip was that of climbing from an altitude of 1500 ft. at the base of the mountain to 5600 ft. at the top, which is a distance of nine miles. The new one-hundred inch telescope, the largest in the world, proved the principal object of interest, as it is nearing completion. The greater part of the excursionists "stargazed" until after midnight.

T. J. ROYER,
*Section Secretary.*

### MILWAUKEE

*November 14.* B. E. Fernow, Jr., gave an illustrated talk on the Design and Application of Magnetic Clutches. Mr. Fernow showed a great number of interesting pictures and demonstrated an actual clutch.

Following the meeting there was a general discussion, after which a buffet luncheon was served.

F. H. DORNER,
*Section Secretary.*

### PHILADELPHIA

*November 27.* This meeting of the Section was opened with a statement of the progress being made by the various sections, by D. Robert Yarnall, Chairman of the Committee on Sections. Mr. Yarnall emphasized the fact that some of the newer western sections are extremely active and progressive. Mr. Ernest Hartford, secretary of the Committee on Sections, spoke upon the subject of section activities. A motion made by Mr. L. H. Kenny was carried, directing that the chairman appoint a committee on papers. Prof. Walter Rautenstrauch, member of the Committee on Sections, presented the paper of the evening, entitled Manufacturing in Relation to Banking, Research and Management.

Offensive Against the Submarine, by Joseph A. Steinmetz, was the subject of the evening at a joint meeting of the Section with The Franklin Institute on December 11. A complete report of this meeting will be given in the following issue of THE JOURNAL.

JOHN P. MUDD,
*Section Secretary.*

### PROVIDENCE

*December 10.* Frederick J. Hoxie, Mem.Am.Soc.M.E., spoke before the Fire Insurance Engineering Section, giving a most interesting paper on the Fire Hazards of Celluloid. On Tuesday, December 11, the Designers and Draughtsmen Section listened to a paper by J. S. White, of the Morse Chain Company, Ithaca, New York, who talked mainly on the engineering of silent-chain drives; a very interesting discussion followed. On December 12, George F. Wheaton, of the J. & P. Coats, Ltd., read a paper on Boiler Efficiencies before the Power Section. The Brown University Student Section of the Providence Engineering Society held a meeting on this date, at which Professor Hardy Cross gave a paper on How an Engineer Gets His Facts.

JAMES A. HALL,
*Correspondent.*

### ST. LOUIS

*November 9.* The Associated Engineering Societies of St. Louis held a farewell testimonial dinner tendered to John Hunter, Mem. Am.Soc.M.E., who for the past twelve years has been Chief Engineer of the Union Electric Light and Power Company, and who has recently been called into the service of the Government in the capacity of district manager for the Emergency Shipbuilding Corporation, with headquarters in New York. The occasion found the Engineers of St. Louis meeting with mingled feelings; pride that one of their members had been chosen for this important work, and regret that they were to lose a man who had done so much for the profession during his many years' residence in St. Louis, and who had made a friend of every engineer with whom he had come in personal contact. Mr. Hunter has always taken active interest in the work of The American Society of Mechanical Engineers and has been elected Vice-President for the coming year.

The regular monthly meeting of the Section was held on November 23, at which the affairs of the Society were discussed, and a resolution adopted to the effect that the Executive Committee of the St. Louis Section extend to the Council a cordial invitation to hold a meeting in St. Louis at such time as may be found most convenient.

H. W. RADCLIFFE,
*Section Chairman.*

### WORCESTER

*November 22.* The first meeting of the Worcester Section was held in the Electrical Building of the Worcester Polytechnic Institute, and the subject presented for discussion was Fuel Conservation. The section was fortunate enough to secure Dr. Ira N. Hollis, President of the Society, and Prof. L. P. Breckenridge, Mem.Am.Soc.M.E., to open the discussion. Dr. Hollis took up the broader view of conservation as it appertained to all our resources, emphasizing the point that some of our resources, such as our foods, are recurring crops, while others, like coal, once used are gone forever.

Professor Breckenridge dealt with the conserving of our coal supply. He displayed lantern slides, showing where the coal is used and what industries are the largest users. He closed his presentation of the subject by outlining the ways in which coal can be saved.

Previous to the discussion, a buffet luncheon was served at the home of Dr. Hollis.

H. P. FAIRFIELD,
*Section Secretary.*

# STUDENT BRANCHES

## Conference of Student Branches

At the Student Branch Conference held on Wednesday, December 5, in connection with the Annual Meeting, much was developed of interest, and although it was found that our Branches have lost a great percentage of their members due to the war, plans are being laid to carry on their activities as in previous years.

The representatives of the following colleges were present, and gave brief talks on how the war had affected the conduct of their affairs, and what plans were being laid for future meetings:

Armour Institute of Technology.....Mr. A. H. Anderson
State University of Iowa.....Mr. Sheatsley
State University of Kentucky.....Prof. F. Paul Anderson
Massachusetts Institute of Technology.....Mr. A. Saunders
New York University.....Mr. H. G. Tyler
Polytechnic Institute of Brooklyn.....Mr. Wm. Sumner
Rensselaer Polytechnic Institute.....Mr. R. P. Kolb
Stevens Institute of Technology.....Mr. McDermot
University of Washington.....Mr. McCoy
Worcester Polytechnic Institute.....Mr. R. C. Lewis
Yale University.....Mr. R. Wier, Jr.

While some of the colleges have been affected less seriously than others, none have escaped without feeling some strain of the present war conditions. Massachusetts Institute of Technology reported a loss of 50 per cent of its members and a number of the other colleges reported losses from 30 per cent to 50 per cent. With the provision just made by the Government to enlist all engineering students in the Engineer Reserve, and to

exempt them from the national draft, many more men will now probably stay in the institutions and complete their courses.

On account of the loss of professors in the various colleges a great many courses have been eliminated from the college curricula entirely and outdoor drills substituted. While the kind of training varies in the different colleges, nearly every college devotes part of the time to military training. Reports from a few of the colleges in this connection follow:

At Columbia University a complete submarine has been installed in the laboratory and the students are instructed in the testing of motors, engines, etc. In Cambridge are the aviation school and the only naval school of its kind in the country. At Ohio State University there is an aviation school. At Stevens Institute of Technology military drills are required two days a week; Stevens has received an assignment of guns and the students receive instructions in the manual of arms. While it has been a regular requirement at the University of Washington since 1909 that strict military training is required for two years, this training has now been made more severe and students receive instructions under the supervision of U. S. Army officers and have three drill parades a week. Yale University has thirty horses which are utilized in the artillery training the students are receiving.

F. R. HUTTON, *Chairman,*
*Committee on Student Branches.*

# Student Branch Meetings

***(Some of the Student Branch Reports are unavoidably held over on account of lack of space, but will be published in the February issue.)***

## ARMOUR INSTITUTE OF TECHNOLOGY

*November 27.* One of the main objects of the Branch this season is to have short talks given by three or four members of the Society, on some technical subject. At the last meeting K. A. Taylor spoke on the construction, assembling and testing of different types of Fairbanks-Morse Gas Engines. Mr. Rehfelt discussed the modern dispensing machine, such as the type used in the automatic restaurant. Mr. Wutheimer spoke on the design, remodeling, process of construction, and routing through the shops of different types of valves as used on gasoline motors, as made by the American Car & Foundry Company.

The officers of the Branch for the coming year are as follows: President, D. A. Taylor; vice-president, J. A. Keeth; secretary, V. A. Kerr; treasurer, H. Anderson.

The Armour Institute of Technology has discontinued athletics this year, although it strongly advises its students to make use of the gymnasium to keep themselves fit for Government service, and has made it compulsory that the freshmen and sophomores take military training one afternoon a week. The training is left optional to the junior and senior classes, but a large majority of both upper classes are drilling.

Under the instruction of Professor Libby and Professor Pebbles, a class of marine engineers is now meeting four times a week.

V. A. KERR.
*Branch Secretary.*

## UNIVERSITY OF CINCINNATI

*October 19.* The spirit and ardor shown at the first meeting of the season gave every indication that the Branch would be very active this year. An entertainment and membership committee, along with a new publicity man, were appointed. An orchestra and several good speakers was the program offered for the evening. Among other visitors several of the alumni of the Engineering College, along with a few professors, were present. J. B. Stanwood, Mem.Am.Soc.M.E., gave a very interesting talk on The Power to Visualize Objects of Study. He suggested that engineering problems be solved, as far as possible, by means of a rational reasoning process rather than by the use of handbook rules and formulæ. Mr. Stanwood solved several problems dealing with the valve motion of the simple slide-valve engine to illustrate his remarks. Professors Jenkins and Joerger also addressed the students and strongly advocated Mr. Stanwood's ideas.

At the second meeting of the Branch on November 23, Wm. A. Greaves, of the Greaves-Klusman Tool Company, Cincinnati, spoke of his engineering experiences. The talk presented many interesting problems such as the repairing of very large anchors, the underlying principle of the building of the Mississippi Jetties, and Captain Eads's ship railway. The speaker concluded his talk by urging the students to do everything in life with a determination to win.

It was decided at this meeting to make an inspection trip to the new plant of the Union Gas & Electric Company, now under construction. At the present time the construction company is placing the condensers and the boilers. This plant is to be one of the largest of its kind in that part of the country. Up to the present time the students have been studying the foundation as a part of their steam-power-plant course in steam engineering.

C. L. KOEHLER.
*Branch Secretary.*

## LEHIGH UNIVERSITY

*November 13.* The first meeting of the Branch for the season was given over entirely to a business session and the electing of the officers for the present year, which resulted in the following: President, W. R. Penman; secretary, N. Dmytrow; treasurer, R. M. Stettler.

P. B. DE SCHWEINITZ.
*Honorary Chairman.*

## UNIVERSITY OF MAINE

*November 23.* The first meeting of the Branch for the season was given over to a short business session, and the electing of the new officers for the present year, which resulted in the election of I. L. Newman, president; I. S. Hanson, vice-president; D. F. Theriault, secretary and treasurer; A. F. Barnard, R. L. Goggins, K. B. Noyes, as the Executive Committee, and Prof. W. J. Sweetser, Mem.Am.Soc.M.E., Honorary Chairman.

D. F. THERIAULT.
*Branch Secretary.*

## MICHIGAN AGRICULTURAL COLLEGE

*November 1.* The first meeting of the Branch for the season was given over entirely to the electing of the new officers for the present year, and the discussion of campaigns for membership. The results of the election were as follows: President, H. T. Froelich; vice-president, W. G. Retzlaff; secretary, H. M. Sass; treasurer, F. O. Stang.

H. M. SASS,
*Branch Secretary.*

## PENNSYLVANIA STATE COLLEGE

*November 16.* The first meeting of the Branch for the season began by a short business session, after which the meeting was turned over to the Program Committee. Prof. R. B. Fehr, Mem. Am.Soc.M.E., gave an illustrated talk on the romantic development of the steam engine, beginning with the earliest forms of which there is any record and tracing its development to the present day. Dean R. L. Sackett gave a short talk to the students with reference to the activities of the Branch. There followed a few selections by the Mandolin Club, after which refreshments were served. Prof. E. A. Fessenden, Mem.Am.Soc.M.E., Professor Resides, and Prof. A. F. Wood, Mem.Am.Soc.M.E., then gave short talks, completing the program of a very successful evening.

H. W. PARTHESUN,
*Branch Secretary.*

## THROOP COLLEGE OF TECHNOLOGY

*November 8.* Dr. Ira N. Hollis, Pres.Am.Soc.M.E., was present as speaker and guest of honor at the opening meeting of the Branch this year. Dr. Hollis addressed the students on the War, Conservation, The Part of Engineering in the War, and told his philosophy of life. Everyone present was much impressed by

this stirring address and the true simplicity of this really great man.

Because of the enlistment of so many of its students the Branch has had some difficulty in organizing this year. Plans have been made to coöperate with the Student Branch of the American Institute of Electrical Engineers, and to have joint meetings once a month. The outlook for a successful year is very good so far.

RETLA ALTER,
*Branch Secretary.*

### UNIVERSITY OF WASHINGTON

*November 16.* K. B. Sallee was elected corresponding secretary, and the following Committees appointed: Program committee, Prof. J. H. Macintire, *chairman*, Buel B. Blake, and Earl Elvidge; election committee, Valentine Hoffman, *chairman*, Lester R. McLeed, and Leroy Burque. Jasper F. Keuhnert was elected freshman representative, and Arthur W. Stewart sophomore representative. Plans were completed for the coming smoker which it was decided to hold on November 22, at 8 p. m.

K. B. SALLEE,
*Branch Secretary.*

### WASHINGTON UNIVERSITY

*November 7.* The first meeting of the season resulted in the following elections: Chairman, Ernest E. Bissett; vice-president, Francis Packer; secretary, Fairman B. Lee; treasurer, Corwin P. Rummel. Plans for future meetings and a smoker were discussed, after which Professor Macintire gave a short talk on the aims and ideas of the Society. Representatives from the freshman and sophomore classes were appointed to get all underclassmen interested.

FAIRMAN B. LEE,
*Branch Secretary.*

### UNIVERSITY OF WISCONSIN

*October 18.* The season opened with a well attended business meeting and was followed by a talk given by Professor Corp, Mem. Am.Soc.M.E., on the purpose of the Society and the benefits derived by the members.

At the November 11 meeting of the Branch, Mr. Stocker gave an illustrated lecture on his work and experiences in China. He gave a very good description of the life, customs, habits and methods of the Chinese. A business session followed at which the names of the men applying for membership were read for the second time, and the date of initiation was set for Thursday night, November 15.

The December 6 meeting consisted of an interesting and complete talk on Gas Turbines by Glenn Warren. Mr. Warren has spent a great deal of time studying gas turbines, and was therefore well qualified to speak on this subject.

H. K. SHIEKS,
*Branch Secretary.*

### WORCESTER POLYTECHNIC INSTITUTE

*November 16.* The November meeting of the Student Branch was made especially interesting by a discourse on Employment Relations Work, by E. H. Fish, Employment Manager of the Norton Co. The speaker emphasized the attempts made by employer experts to reëstablish the old cordial relations between the employed and the employer. He also told how the up-to-date employment manager coöperated with the welfare work among the employees, even assisting in the employees' home in times of great stress of sickness. In closing he called attention to the present lack of skilled workmen and showed how the Norton Companies established their records of employees as related to the working ability, ambitions, health, etc., of the individual as a means of putting the right man in his proper place.

On December 7, the Branch held a joint meeting with the American Institution of Electrical Engineers, in the Electrical Building. The meeting was opened by Benjamin Luther, chairman of the A.I.E.E. Branch, who introduced Mr. Geo. M. Eaton, W.P.I., '96, now head of the Railway Division of the Westinghouse Electric & Manufacturing Co. Mr. Eaton gave an illustrated lecture on The Other Half of Engineering, and showed how a new machine or apparatus is seldom in its best form as first designed and tested. By displaying a variety of designs the speaker showed how new goods are often defective, as first constructed, and how these inevitable defects are corrected. The talk was both instructive and unique, inasmuch as it dealt with the difficulties of engineering rather than with the successes. Mr. Eaton showed the students that an engineer's job sometimes is that of pulling batters out of a hole and is not always easy.

H. P. FAIRFIELD,
*Branch Secretary.*

### KANSAS STATE AGRICULTURAL COLLEGE

*November 22.* James I. Brady, senior in mechanical engineering, gave a paper entitled Ordnance Work. He dwelt upon the organization of the Ordnance Department and the importance of the work at the present time, laying emphasis on the part technically trained men might perform in this field of work. The second number on the program was a review of the September issue of THE JOURNAL, presented by Mr. Harry Bell, Junior in Mechanical Engineering. Mr. Bell laid special emphasis on the article of "Modern Locomotive Practice."

At the December 6 meeting of the Branch Seibert Fairman presented a paper entitled Aviation Training. The subject matter was gathered from current magazines and from reports of students of this school who are at present training as aviators. This subject proved very interesting and of much importance because of the fact that a large per cent of the students are entering the aviation service of the Government. Mr. Gordon Hamilton, junior in mechanical engineering, presented a review of the November issue of THE JOURNAL. Mr. Hamilton in his review spoke on the two articles of Accident Prevention, and Labor Turnover Records and the Labor Problems.

I. O. MALL,
*Branch Secretary.*

## College Reunions

The College Reunions were held on Friday night of the Annual Meeting as in previous years, and if the war lessened the number somewhat, nevertheless the reunions that were held were very thoroughly enjoyed.

The Cornell reunion had as its guests Mr. Lawrence Sperry, Prof. D. S. Kimball and Mr. Robert Lee. Mr. Sperry gave an interesting talk of his "flying" experiences; Professor Kimball spoke on the wartime conditions at the University and Mr. Lee illustrated his talk on the gyroscope with lantern slides and models. Mr. C. F. Hirschfeld and Mr. W. W. Macon acted as toastmasters at the dinner.

The Massachusetts Institute of Technology had forty A.S.M.E. members at its reunion at the Technology Club. After an informal dinner Mr. James P. Munroe, '82, gave a talk on Washington in War Times.

Purdue held its annual reunion at the Phi Gamma Delta Club, and over thirty members were present, including as guests Dr. W. F. M. Goss, Prof. C. A. Waldo, Dean C. H. Benjamin and Mr. Angus Sinclair, all of whom gave very interesting talks. Dean Benjamin spoke on what the University and graduates are doing for their country at the present time, while Dr. Goss brought home forcibly the necessity of conserving the number of men training for the engineering profession. Congratulations were telegraphed the University on its patriotic help and services at this time.

Stevens Institute of Technology gave a supper dance at the Hotel Astor, omitting their usual theater party in view of the seriousness of the times. The dance was most successful and voted by all one of the most enjoyable dances ever given by Stevens.

The University of Kentucky N. Y. Club held an informal smoker at Keen's Chop House, having as their guests the out-of-town alumni who were in the city attending the Annual Meeting, as well as several other engineers that Kentucky would be proud to claim as hers. Professor Anderson, dean of the mechanical and electrical colleges of the University, and President Wendt of the Buffalo Forge Co. gave very interesting impromptu talks. The attendance was somewhat reduced owing to the fact that so many Kentucky men are in the national service.

Worcester Polytechnic Institute held its reunion in the Society rooms. Following a buffet supper remarks were made by three Past-Presidents of the Society, Dr. Ambrose Swasey, Dr. John A. Brashear and Dr. Ira N. Hollis, President of the Institute. The other guests who addressed the meeting were Prof. M. E. Cooley, of the University of Michigan, and Prof. Chas. M. Allen, of Worcester, who gave an interesting account of the present activities of the Institute.

# ROLL OF HONOR

THE SOCIETY'S SERVICE FLAG unfurled at the Annual Meeting bore the number 433 in stars, which was the total number of members in the Service of which the Society had notification on December 4, 1917. This new list of names received since the publication of the previous list brings the total to nearly 600.

ADAMS, PORTER H., Office of Naval Intelligence, United States Navy.
ADAMSON, KEITH F., Captain, Inf. U. S. R., U. S. Expeditionary Forces.
ARISON, E. E., Major, Production Section, Gun Division, Ordnance Department, U. S. R.
AUSTIN, RICHARD S., Aviation Student, Division 5, Foreign Detachment, American Expeditionary Forces.

BACON, HOWARD E., Company C, 318 Field Signal Battalion, Camp Jackson, Columbia, S. C.
BAIRD, JAMES T., JR., Captain, Ordnance Department, United States Reserve.
BALDWIN, BERT L., Major, Engineer Officers' Reserve Corps.
BASSETT, CHARLES K., Lieutenant, Ordnance Department, United States Reserve.
BEEBE, LAWRENCE L., Captain, Engineer Officers' Reserve Corps.
BEHR, F. J., Major, Coast Artillery Corps, United States Army.
BENEDICT, BYRON W., First Lieutenant, Ordnance Section, Officers Reserve Corps, United States Army.
BENHAM, W. L., Major, Quartermaster Officers' Reserve Corps, Camp Funston, Ft. Riley, Kan.
BENSON, H. S., First Lieutenant, Ordnance Department, Inspection Section, U. S. R.
BILLINGS, A. W. K., Lieut.-Commander, care of Commander U. S. Naval Aviation Forces, Paris, France.
BIRDSEYE, GARNER K., First Class Private, Aviation Section, Signal Corps, United States Army.
BOWES, LAWRENCE C., 332nd Field Artillery, U. S. A.
BOYD, FRANK F., Lieutenant, United States Naval Reserve Force.
BRADFORD, J. S., Captain, 103rd Engineers, Company B, Camp Hancock, Augusta, Ga.
BRADY, GEORGE S., Captain, American Ordnance Base Depot in France.
BREADY, WILLIAM M., JR., First Lieutenant, 108th Engineers, Company E, 33rd Division, Camp Logan, Texas.
BREWSTER, HENRY B., Captain, 303rd Regiment of Engineers, Camp Dix, N. J.
BROWN, EDWARD W., Lieutenant, United States Naval Reserve Force.
BUCKLEY, JOHN H., Captain, Equipment Engineer, Small Arms Division, Frankford Arsenal.
BYLLESBY, H. M., Major, U. S. R., Signal Corps Headquarters.

CAHILL, EDWARD H., First Lieutenant, Field Artillery Section, Carriage Division, Ordnance Department.
CAMPBELL, JEREMIAH, Major of Engineers, United States Reserve Corps, American Expeditionary Force, France.
CARPENTER, CHARLES A., First Lieutenant, Ordnance Section, Officers' Reserve Corps, United States Army.
CHAPIN, WARREN W., Captain, Engineers, United States Reserve.
CHRISTIE, A. G., Private, Reserve Officers' Training Corps, Johns Hopkins University.
CHURCH, ELIHU C., Captain, Engineer Officers' Reserve Corps, Adjutant 117th Engineer Regiment, 42nd Division.
CLARK, JOHN W., Second Lieutenant, Engineer Officers' Reserve Corps, United States Army.
CLAUSSEN, HOWARD P., Ensign, United States Naval Reserve Force, Class 5-(Naval Reserve Flying Corps).
CLEMONS, ROBERT S., Major, Commanding 506th Engineering Service Bureau, Camp Lee, Va.
CLUCAS, GEORGE W., Private, Company G, First Reg. 122 Reserve Militia.
COHEN, ABRAHAM SAUL, First Lieutenant, Ordnance Reserve Corps, United States Army.
COLE, C. S., Captain, Ordnance Reserves.
CONANT, WILLIAM S., Captain, Ordnance Officers' Reserve Corps.
CONROY, RAYMOND, Second Lieutenant, Coast Artillery Corps, United States Army.
COOK, WILLIAM P., JR., First Lieutenant, Ordnance Officers' Reserve Corps.
CYPHERS, JAMES F., First Lieutenant, Ordnance Officers' Reserve Corps.

DAILEY, FRED A., Captain, Engineer Officers' Reserve Corps.
DELEMOS, FREDERICK P., Second Lieutenant, Infantry Officers' Reserve Corps.
DE VISSER, JOHN H., Captain, Officers' Reserve Corps, Ordnance Department, Supply Division.
DEXTER, HARRIS E., Lieutenant, 30th Engineers (Gas and Flame).
DICKERSON, H. S., Captain, United States Reserve.
DIEMER, HUGO, Major, Ordnance Officers' Reserve Corps.
DIETRICH, FRED E., Machinist's Mate, Second Class, Naval Coast Defense Reserve.
DRESSLER, L. RICHARD, First Lieutenant, Ordnance Department, Carriage Division, Officers' Reserve Corps.
DREW, WILLIAM N., Second Lieutenant, 323rd Field Artillery.
DUNCAN, J. C., Captain, Quartermaster Corps, U. S. R.

EATON, P. B., Second Lieutenant of Engineers, United States Coast Guard.
EDE, ALBERT B., Second Lieutenant, Coast Artillery Corps, U. S. A., American Expeditionary Forces.
EDMONDSON, RALPH S., First Lieutenant, 27th Engineers, Engineers' Reserve Corps.
ESTABROOK, M., Captain, Ordnance Department, United States Army.
EVANS, GEORGE A., Lieutenant (Junior Grade), United States Naval Reserve Force.
EVANS, LYNN B., Ensign, United States Naval Reserve Force.
FABENS, ANDREW L., First Lieutenant, Ordnance Reserve Corps.

FERNSTROM, F. S., United States Naval Reserve Force.
FESSENDEN, C. H., Captain, Ordnance Reserve Corps, Ordnance Department, Frankford Arsenal, Philadelphia, Pa.
FIELD, FREDERICK C., Captain, Ordnance Officers' Reserve Corps, Small Arms Division, Ordnance Department.
FISH, M. R., Private, Mass. State Guard, Company H., 19th Regiment.
FISHER, R. R., First Lieutenant, 106th Engineers, 31st Division, Camp Wheeler, Macon, Ga.
FISHLEIGH, WALTER T., Major, Sanitary Corps, N. A., Surgeon General's Office, Washington, D. C.
FORDYCE, JOHN R., Major Engineers, U. S. R.
FORFAR, DONALD M., First Lieutenant Engineers, U. S. R. Engineer Officers' Reserve Corps.
FOWLER, WALLACE S., First Lieutenant, Ordnance Officers' Reserve Corps, Production Section, Carriage Division.
FOSTER, ERNEST H., Ensign, United States Naval Reserve, Class No. 4.
FRANCE, JOHN E., First Lieutenant, Engineer Officers' Reserve Corps, 5th Engineer Corps, Company F.
FRANKET, WILLIAM F., Second Lieutenant, Ordnance Officers' Reserve Corps.
FRANKLIN, BENJAMIN A., Major, Ordnance Department.
FREDERICK, ALVAH B., Second Lieutenant, Ordnance Officers' Reserve Corps.
FREEMAN, B. W., First Lieutenant, Ordnance Department.
FRIEDMAN, FERDINAND J., First Lieutenant, Supply Division, Ordnance Department, U. S. R.
FRITZ, A. L. G., Cadet, Squadron B, Signal Corps, Aviation Section, Officers' Reserve Corps, United States Army, Wright Field, Dayton, Ohio.

GIBBS, PAUL H., First Lieutenant, Ordnance Department, Inspection Section, Gun Division, U. S. R.
GILSON, JOSEPH L., Corporal, Company F, 302nd Engineers, United States Army.
GITHENS, THOMAS F., First Lieutenant, Ordnance U. S. R., Trench Motor Design.
GLEASON, GILBERT H., Trooper, First Troop, (Cavalry) Mass. State Guard.
GRAY, H. LIGGETT, Chief Machinist's Mate, U. S. Naval Reserve.
GREENE, AUGUSTINE E., Major, Ordnance Officers' Reserve Corps.
GREENLEAF, GEORGE E., Major, Ordnance Bureau, United States Army.
GREF, W. H., Lieutenant, Torresdale Station, Philadelphia, Pa.
GUEST, W. E., Captain, Ordnance Officers' Reserve Corps.

HANSEN, F. D., First Lieutenant, Reserve Corps, Ordnance Department.
HARKNESS, V. F., Lieutenant (Junior Grade), United States Naval Reserve Force.
HENRY, VERNOR S., First Lieutenant, Ordnance Department, United States Reserve.
HERRICKS, E. A., Captain, Ordnance Officers' Reserve Corps.
HOBBS, GEORGE W., First Lieutenant, Ordnance Section, Officers' Reserve Corps.
HOFFMAN, JOHN ERNEST, Second Lieutenant, Engineer Officers' Reserve Corps, American Expeditionary Forces.
HORTON, ELIAS Q., Ensign, U. S. Naval Reserve Force, on board U. S. S. South Carolina.
HOWARTH, JACOB M., First Lieutenant, Officers' Reserve Corps, Intelligence Officer, 342nd Inf. Headquarters, Camp Grant, Ill.
HUBBELL, ARTHUR C., First Lieutenant, Purchase Section Small Arms Division, Ordnance Department.
HUNICKE, C. CAMPBELL, Sub-Inspector of Ordnance, Ordnance Department, United States Navy.
HUNT, H. B., Major, Ordnance Department, Gun Division.
HUNTER, CHARLES F., Captain, Ordnance Reserve Corps.

JACKSON, JOHN P., Major, Engineer Officers' Reserve Corps.

KAEMMERLING, GUSTAV H., Second Lieutenant, U. S. M. C., First Aviation Squadron.
KEHL, R. J., First Lieutenant, Division of American Ordnance Base Depot in France.
KELLOGG, CHARLES D., First Lieutenant, Ordnance Department, Small Arms Division.
KNOWLTON, F. K., Captain, Ordnance Reserve Corps, United States Army.
LAMBELET, CARL H., First Lieutenant, Ordnance Department, United States Reserve.

LAMOREE, J. K., First Lieutenant, Engineers, U. S. R., Officers' Reserve Corps, Engineer Section.
LANCASTER, WILLIAM C., Captain, Engineer Officers' Reserve Corps.
LANGVILLE, H. B., Lieutenant (Junior Grade), Naval Coast Defense Reserve, U. S. Naval Reserve Force.
LEONARD, ELTON IRBOTSON, Canadian Expeditionary Force in France.
LEISEN, THEODORE A., Major, Quartermaster Corps, Utilities Department, 85th Div., U. S. Army.
LEWIS, KENNETH B., Private, Company H, 19th Infantry, Mass. State Guard.
LIGHTOWLER, GEORGE R., First Lieutenant, Ordnance Reserve Corps, Watertown Arsenal.
LUEHRMANN, HUGH, Second Lieutenant, Signal Reserve Corps, U. S. School for Military Aeronautics, Cornell University, Ithaca, N. Y.
LYON, PERCY S., Captain, Coast Artillery Reserve Corps, Ft. Monroe, Va.
LYSTER, THOMAS L. B., Major, U. S. A., Air Service, American Expeditionary Forces, France.
LYTLE, CHARLES W., Private, Aviation Section, Enlisted Reserve Corps.

MCGREW, J. A., Major, Quartermaster Reserve Corps, Cantonment Constructing Department.
MCKISSICK, ELLISON S., First Lieutenant, Company F, 306th Engineers, U. S. R.
MARSHALL, HAROLD F., First Lieutenant, Aviation Section, Signal Officers' Reserve Corps, United States Army.
METCALF, GEORGE R., First Lieutenant, Ordnance Officers' Reserve Corps, Fort Hancock, N. J.
MILTENBERGER, GEORGE K., First Lieutenant Engineers, United States Reserve, Company D, 314th Engineers, 89th Division, Camp Funston, Kan.
MIXTER, GEORGE W., Major, Signal Corps, Equipment Division.
MONAGHAN, JAMES F., Captain, Ordnance Officers' Reserve Corps, United States Army.
MORGAN, JOHN D., First Lieutenant, Engineer Officers' Reserve Corps.
MORRIS, THOMAS B., First Lieutenant, Engineers, United States Reserve.
MURRIE, JOHN L., Lieutenant, United States Naval Reserve Force.

NEIDIG, W. N., First Lieutenant, Signal Corps, United States Reserve, Construction Division, Aviation Section.
NEWCOMB, BENJAMIN R., First Lieutenant, Ordnance Reserve Corps, United States Army.
NEWCOMB, FRANKLIN L., First Lieutenant, Company C, 24th Regiment of Engineers, Engineers Reserve Corps.
NIELSEN, LAWRENCE H., Naval Reserve Flying Corps.

OBERLIN, E. G., Lieutenant Commander, United States Navy.
ORRISON, THOMAS E., First Lieutenant Engineers, U. S. R., 2nd Company, 2nd Engineers Officers' Training Camp, Fort Leavenworth, Kan.

PANCOAST, FRED L., Captain, Ordnance Department, United States Reserve.
PARR, HARRY L., Lieutenant, United States Naval Reserve Force.
PENNEY, RUPERT L., Captain, Ordnance Officers' Reserve Corps.
PERRY, E. D., First Lieutenant, Equipment Division, Purchasing Section, Ordnance Corps.
PETERS, H., Signal Corps, U. S. A., Inspection and Specifications Section.
POPE, CLARENCE JAMES, First Lieutenant, Ordnance Department, U. S. R., Motor Section.
POPE, FREDERICK, Captain, 30th Engineers, Gas and Flame Division.

REIMER, A. A., Major, 305th Engineers, 80th Division.
REITZ, WALTER R., First Lieutenant, Ordnance Department, U. S. A.
RHAME, FRANK P., First Lieutenant, Ordnance Department, United States Reserve, Inspection Section.
RIPLEY, WILLIAM H., First Lieutenant, Ordnance Department, United States Reserve.
RITTENOUR, FREDERICK H., Captain, Engineer Officers' Reserve Corps.
ROCKWELL, SHERBURNE B., Chief Petty Officer, U. S. Navy, on board U. S. S. Noma.
ROESEN, ROBERT H., Sergeant, Company D, 302nd Engineers, National Army.
ROSE, C. E., Captain, Engineer Officers' Reserve Corps.
ROSS, CLELAND COLDWELL, First Lieutenant, Ordnance Reserve Corps, Fort Hancock, N. J.

SAMPTER, HERBERT C., Aviation Section, Signal Corps, Enlisted Reserve, U. S. A.
SAMSON, CHARLES L., First Lieutenant, Engineer Officers' Reserve Corps.
SAVAGE, L. L., Lieutenant, 309th Engineer Regiment, U. S. A.
SCHMIDT, EDWARD C., Major, Ordnance Reserve Corps, Carriage Division, Inspection Section.
SCHWENKER, ROBERT F., Second Lieutenant, Field Artillery, Officers' Reserve Corps, U. S. A.
SEDGWICK, H. A., Prov. Lieutenant-Commander, United States Naval Reserve Force.
SEED, CHARLES R., Ensign, United States Naval Reserve Force, U. S. S. Waukiva.
SEGALOWITZ, OSCAR, First Sergeant, Company D, 302nd Engineers.
SHEA, THOMAS F., First Class Private, Aviation Section S. C.
SHEEDY, M. M., Captain Engineers U. S. R., Company C, 21st Regiment Engineers (Light Railway).
SIMMONS, HARRY M., Second Lieutenant, 6th Division Engineers, Field Train, U. S. A.
SMITH, ROBERT W., Second Lieutenant, Engineer Officers' Reserve Corps, 106th Engineers.
SNAVELY, A. BOWMAN, Second Lieutenant, Coast Artillery, Officers Reserve Corps, Fort Dupont, Del.
SPAULDING, H. C., Captain, U. S. R., Purchase Section, Gun Division, Ordnance Department.
SPENCER, C. G., First Lieutenant, Aviation Section, Signal Officers' Reserve Corps.
SPENCER, F. G., Captain, Ordnance Department, U. S. R.
STEM, CLIFFORD H., Second Lieutenant, Engineers, U. S. R.
STEWART, HARRY M., Sergeant Motor Truck 375, Motor Supply Train 409, Quartermasters' Corps, U. S. A.
STICKNEL, C. P., First Lieutenant, Engineer Reserve Corps.
STRINGHAM, JOSEPH S., Captain, Ordnance Department, Rock Island Arsenal, Ill.
SWAIN, PHILIP W., Second Lieutenant, Field Artillery Reserve Corps, B Battery, 303rd Field Artillery.
SWETTING, J. RODNEY, Second Lieutenant, Engineer Officers' Reserve Corps.

TALBOT, JOHN ALDEN, Second Lieutenant, Field Artillery, United States Reserve.
TANGEMAN, W. W., Lieutenant, United States Army.
TERRY, M. V., Captain, Engineer Officers' Reserve Corps.
THOMAS, FELIX, First Lieutenant, Motor Equipment Section, Ordnance Department, Carriage Division, U. S. R.
THOMAS, WINTHROP G., Corporal, Depot Company H, Signal Corps, United States Army.
THOMPSON, PAUL W., First Lieutenant, Ordnance Department, Gun Division.
TOMPKINS, HAROLD D., Lieutenant, Company C, 104th Field Signal Battalion, Camp McClellan, Ala.
TURNER, CHANNING, First Lieutenant, Field Artillery, Officers' Reserve Corps.
TUSKA, GUSTAVE R., Major, Engineer Officers' Reserve Corps.

VAN DENBURGH, O. A., JR., Private, Enlisted Ordnance Corps, National Army.
VINNEDGE, EARLE W., Second Lieutenant, Engineers U. S. R., American Expeditionary Forces.

WAHL, JAMES H., Lieutenant (Junior Grade), United States Naval Reserve Force.
WALKER, L. E., First Lieutenant, Ordnance Department, Production Section, Carriage Division, U. S. R.
WALL, GEORGE L., Major, Ordnance Reserve Corps.
WALSH, WALTER V., Aviation Section, Signal Corps, U. S. Army.
WATERS, EVERETT O., Second Lieutenant, Ordnance Section, Officers' Reserve Corps.
WELLS, A. E., Major, 121st Infantry, U. S. A.
WHYTE, JESSEL S., Captain, Company F, 310th Engineers, United States Army.
WILLIAMS, H. E., Captain, Field Artillery, Officers' Reserve Corps.
WILLIAMS, HAROLD J., First Lieutenant, Ordnance Department, United States Reserve, Carriage Division, Field Artillery Section.
WILLIAMS, SAMUEL S., Aviation Section, Signal Reserve Corps.
WOODCOCK, WILLIAM E., Second Lieutenant, Engineers, United States Reserve.
WOODWARD, HIRAM W., Second Lieutenant, 106th Engineers, U. S. R.
WOOLSON, CLIFFORD G., Captain, Company A, 104th Engineers, S. E. Department, 29th Division, United States Army.
WRIGHT, STANLEY, Second Lieutenant, 314th Engineers, Camp Funston, Kan.

YOUNG, JOHN P., Fifth Company, Coast Artillery Corps, U. S. A., Fort Hancock, N. J.

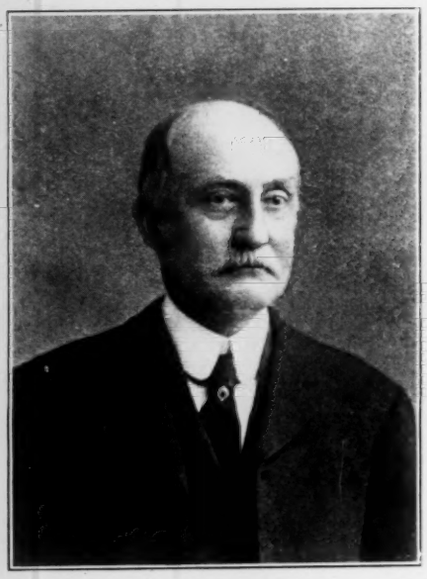
# NECROLOGY

## E. W. GRIEVES

E. W. Grieves was born in Delaware in 1843 and attended the public schools in that state. He spent a four years' apprenticeship at woodworking, and then served several years as a patternmaker on ship and car work and as a designer and constructor of cars.

He became the chief draftsman and assistant superintendent of the shops of the Harlan & Hollingsworth Co. Later he was associated with the Baltimore and Ohio Railroad as master car builder. At the time of his death he held the position of mechanical expert with the Galena Signal Oil Co., Franklin, Pa.

Mr. Grieves became a member of the Society in 1891. He died in February 1917.



E. W. GRIEVES

## CHARLES E. NEWTON

Charles E. Newton was born in Hartford, Conn., in 1878. He was educated in the public schools of that city, leaving high school to enter the employ of the Jewell Belting Co. in Hartford as office boy, where his ability speedily won him promotion. He became salesman for the company and was on the road for a number of years, where he had more than usual success.

In 1892 Mr. Newton was elected secretary of the company, and later became assistant manager. His responsibilities increased with time, and in August 1917 he became president of the company.

Mr. Newton became an Associate of the Society in 1895. He died on November 15, 1917.

## HENRY RUTGERS FORD

Henry R. Ford was born on January 30, 1871, in Lawrenceville, Pa. He was educated in Binghamton, N. Y., attending both the grammar and high schools of that city. Later he took the engineering course at Pratt Institute, Brooklyn.

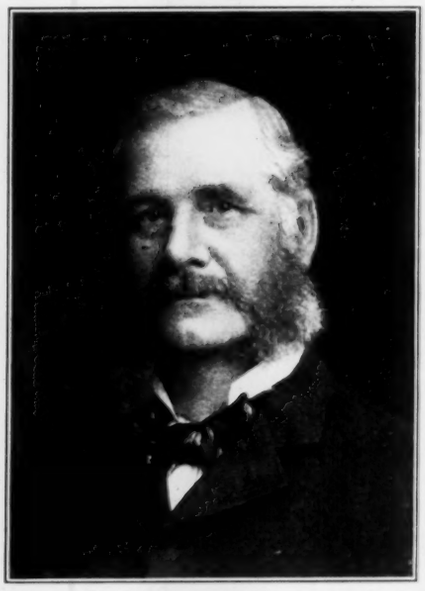
After serving his apprenticeship as electric wireman and as machinist, he obtained a position with the Edison Electric Illuminating Co., New York City, as wireman. In 1893 he was employed by the F. P. Little Company, Buffalo, N. Y., in the capacity of wireman and machinist, later becoming foreman and superintendent. In 1898 Mr. Ford became associated with the firm of McCarthy Bros. & Ford, giving special attention to designing, general engineering and contract work. Throughout Buffalo and its vicinity he designed and installed many steam- and gas-power and lighting plants.

He became a member of the Society in 1914. He died on October 31, 1917.

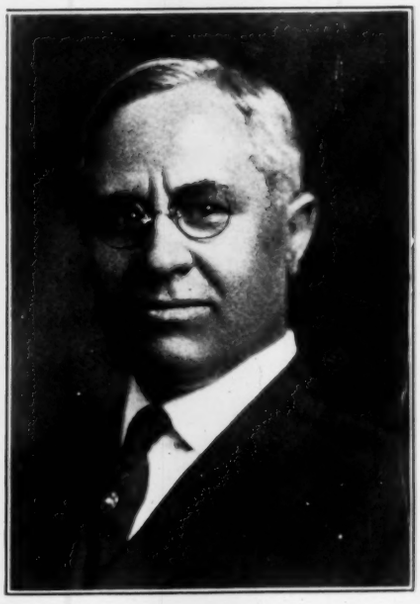
## JOSEPH REID

Joseph Reid was born on November 11, 1843, in Maybole, Ayrshire, Scotland, where he attended the public schools until his eleventh year. He then was apprenticed by his father to learn the joiners' trade, at which he worked for four years. Later he became a machinist in the railroad shops of the Glasgow and Southwestern Railroad Co., Kilmarnock, Scotland.

In 1863 Mr. Reid located in Montreal, Canada, where he worked for a short time as machinist, after which he followed his trade in the United States, and was for some years connected with the



JOSEPH REID



HENRY R. FORD

Baldwin Locomotive Works in Philadelphia. In 1876 he entered the service of the Atlantic and Great Western Railroad Co., now the Erie Railroad, at Meadville, Pa.

In the following year Mr. Reid went to Oil City, where he worked with W. J. Innis & Co. and also with the firm of Malcomson & Patterson. When the latter firm failed in business, he bought their shop and started a small business of his own. In addition to general jobbing work, he made a specialty of refinery supplies. The opening of the Lima, Ohio, oil fields found the refiners unable to take care of the grade of oil produced in that field. The oil, how-

ever, could be used as fuel, and after careful experiment Mr. Reid designed, patented and manufactured a line of oil burners which were very successful and to handle which in 1885 he formed the Reid Burner Co.

As the result of extensive experiment, Mr. Reid brought out in 1894 what is believed to have been the first practical natural-gas engine, and by 1899 had made many improvements in it. The small repair shop became a large factory and the Joseph Reid Gas Engine Co. was organized with Mr. Reid as president. Mr. Reid assisted also in organizing the Frick-Reid Supply Co., a large oil concern in the West, and was vice-president and director of this company. He was also president of the Reid Land & Development Co., which operates fruit ranches in the West.

Mr. Reid became a member of the Society in 1904. He died on October 23, 1917.

### ROWLAND SPENCER BROTHERHOOD

Rowland S. Brotherhood was born in September 1875 in Charleston, S. C. He was educated at the Patric Military Institute, Anderson, S. C.

His apprenticeship was spent with the Betts Machine Co., Wilmington, Del., where he gained his experience in machine-tool designing. In 1902 he accepted a position with the Bethlehem Steel Tool Co., South Bethlehm, Pa., in hydraulic-press and machine-tool designing and on general mill work in charge of the manufacturing drawing office. In 1903 he resigned from this position to become associated with the Portland Iron & Steel Co., South Portland, Me., in general engineering and construction work during the erection of the plant. In 1904 he became connected with the Standard Horse Shoe Co., South Watertown, Mass., as a designer of horse-shoe bending and swedging machines. Later in the same year he took charge of the Brotherhood Railway Supply Co., and the following year accepted a position with the Cambria Steel Co., Johnstown, Pa., in the drafting department on boiler, engine, marine and locomotive work and designing special machinery.

In 1907 Mr. Brotherhood became connected with the Remington-Arms-Union Metallic Cartridge Co., Bridgeport, Conn. His position was in the equipment department, where he designed automatic machinery and was assistant to the chief equipment engineer. After five years he resigned to accept a position with the International Silver Co., Bridgeport, superintending the changing of the entire plant over from steam to electric drive, the installation of a new electric-lighting system and the erection of a new building. From April 1913 until the time of his death Mr. Brotherhood's work dealt with the general mechanical, electrical and efficiency engineering of the company.

Mr. Brotherhood became a member of the Society in 1916. He was the secretary of the Meriden branch of the Connecticut Section. He died on October 13, 1917.

# CANDIDATES FOR MEMBERSHIP

## TO BE VOTED ON AFTER FEBRUARY 10

A TOTAL of 157 new applications for membership in the Society are published in the first list of the new year. This makes 1766 new applications since January 1, 1917. The total membership of the Society is now upward of 8500.

Below is the list of candidates who have filed applications since the date of the last issue of THE JOURNAL. These are classified according to the grades for which their ages qualify them, and not with regard to professional qualifications, i.e., the ages of those under the first heading place them under either Member, Associate or Associate-Member, those in the next class under Associate or Associate-Member, those in the third class under Associate-Member or Junior, and those in the fourth under Junior grade only. Applications for change of grading are also posted.

*The Membership Committee, and in turn the Council, urge the members to scrutinize this list with care and advise the Secretary promptly of any objections to the candidates posted.* All correspondence in this regard is strictly confidential. Unless objection is made to any of the candidates by February 10, and providing satisfactory replies have been received from the required number of references, they will be balloted upon by the Council. Those elected will be notified about March 15.

*NOTE. The Council desires to impress upon applicants for membership that under the present national conditions the procedure of election of members may be slower than under normal conditions.*

### NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

**California**

ELLINGWOOD, E. L., Consulting Mechanical Engineer, National Bank Building, Los Angeles
HALLORAN, RALPH A., Gas Engineer, Standard Oil Co. of California, Whittier
RINGE, WILLIAM H., Pacific Coast Manager, Shepard Electric Crane & Hoist Co., of Montour Falls, N. Y., San Francisco
WHATLEY, ARTHUR C., Mechanical Engineer, Interstate Commerce Commission, San Francisco

**Connecticut**

BAYRER, L. GARFIELD, Production Superintendent, Billings & Spencer Co., Hartford
DEE, WILLIAM V., Secretary, G. Drouve Co., Bridgeport
GLEDHILL, Ernest, Foreman Department Metals, The Remington Arms U. M. C. Co., Inc., Bridgeport
STANLEY, JOHN C., President and General Manager, American & Bristol Manufacturing Co., Bridgeport

**District of Columbia**

GROVE, WILLIAM G., Aeronautical Engineer, Balloon Section, Air Division, Signal Corps, U. S. Army, Washington

**Florida**

AHERN, J. F., Manager, Fairbanks-Morse & Co., Jacksonville

**Idaho**

GOUGH, ACHILLES C., Professor Industrial Arts and Engineering, Idaho Technical Institute, Pocatello

**Illinois**

BUTCHER, IRA A., General Superintendent, A. W. Stoolman, Champaign
DUDLEY, EDWARD F., Mechanical Engineer and Designer, Miehle Printing Press & Manufacturing Co., Chicago
GRIFFIN, LORNE A., Vice-President, American Steam Conveyor Corporation, Chicago
LEVY, LEHMAN, Mechanical Engineer, Wilson & Co., Chicago
LIBBY, EDWIN S., Assistant Professor Experimental Engineering, Armour Institute of Technology, Chicago
WOODMAN, ANDREW W., President, The Joliet Bridge & Iron Co., Chicago

**Indiana**

KJELDGAARD, NIELS C. S., Engineer, Burnoil Engine Co., South Bend
MAYO, EDWARD H., Consulting Engineer, Fletcher Trust Building, Indianapolis

**Iowa**

HENNESSY, WILLIAM J., Inspector of Engines and Boilers, Emergency Fleet Corporation, U. S. Shipping Board, Burlington

**Kansas**

PHELPS, BARTON P., Engineer Shop Extensions, Santa Fé Railway System, Topeka

**Maryland**

DANA, WILLIAM J., Instructor in Mechanical Engineering, Johns Hopkins University, Baltimore
WILKINSON, TURNER A., Sales Manager, Erie City Iron Works, Baltimore

**Massachusetts**

BRADY, JOHN J., Sales Agent, Boston Office, Heine Safety Boiler Co., Boston
DANA, CLARENCE A., Chief Draftsman, Lowell Division, Saco-Lowell Shops, Lowell

DERBYSHIRE, FREDERICK W., Manufacturer of Watch Tools, F. W. Derbyshire, Waltham
INGHAM, IRVING L., Chief Inspector, Gilbert & Barker Manufacturing Co., West Springfield
POLLOCK, ROBERT T., President, Robert T. Pollock Co., Boston

**Michigan**

CLUNE, JOSEPH P., Manager, Soda Ash Department, Solvay Process Co., Detroit
COLE, ROY E., Chief Engineer, Liberty Motor Car Co., Detroit
FIGEE, J. HENDRIK, Engineer, Steere Engineering Co., Detroit
HAZLEY, JOSEPH H., Sales Engineer, Wilmarth & Morman Co., Grand Rapids
WERNICKE, OTTO H. L., President, Wernicke Hatcher Pump Co., Grand Rapids

**Minnesota**

ROWLEY, FRANK B., Assistant Professor Experimental Engineering, University of Minnesota, Minneapolis

**Missouri**

DUFFY, RALPH E., Engineer, Public Service Commission of Missouri, Jefferson City
HEDRICK, EARLE R., Professor of Mathematics, The University of Missouri, Columbia
HOFF, JOHN A., Consulting Engineer, Anheuser-Busch Brewing Association, St. Louis

**Nebraska**

MITCHELL, WILLIAM A., Assistant Chief Engineer, The Great Western Sugar Co., Scottsbluff
SEATON, LAURENCE F., Professor of Mechanical Engineering, University of Nebraska, Lincoln

**Nevada**

MUNROE, HAROLD S., General Superintendent, Consolidated Coppermines Co., Kimberly

**New Jersey**

BEAVERS, GEORGE, JR., Works Manager, American Standard Metal Products Corporation, Paulsboro
COEY, STEWART C., Works Superintendent, The Celluloid Co., Newark
PALM, ROBERT, Chief Engineer, Chrome Steel Works, Chrome

**New York**

ABRAMS, JACK, Jack Abrams & Bro., Inc., Plumbing & Heating Contractors, New York
BETHELL, JAMES G., Patent Attorney, New York
BRIGHTMAN, HENRY M., General Manager, Interests of J. H. Flagler, New York
DAVIS, FRANCIS G., Master Mechanic, American Brass Co., Buffalo
DOWD, ALBERT A., Consulting Engineer, Russo-Baltic Car Works New York
DUNLAP, JOHN R., Editor and Publisher, *Industrial Management*, New York
ESHELMAN, CLARENCE M., Service Engineer, Cameron Machine Co., Brooklyn
FARNHAM, BION B., Superintendent Farnham Mfg. Co., Buffalo
FASTING, SVERRE, Contracting Engineer, Shepard Electric Crane & Hoist Co., Montour Falls
FRASER, JOHN, Consulting Engineer, New York
FULLER, FREDERICK M., Assistant Chief Engineer, Ice Machine Division, De La Vergne Machine Co., New York
GIRTANNER, ALEXANDER, Vice-President, American Steam Conveyor Corporation, New York
GRADY, JAMES J., President and Treasurer, Freeman & Grady, Inc., New York
GUNDLACH, CARL E., Chief Engineer, George Schautz Engineering Co., Inc., Buffalo
LEUDEMANN, JOHN, Chief Engineer and Superintendent, International Exhibit Building, New York
LIPETZ, ALPHONS I., Chief, Locomotive Department, Russian Mission of Ways of Communication, New York
McMILLAN, CHARLES E., Consulting and Inspection, Brazil Railway, New York
MEAGHER, FRANCIS J., Sales Engineer, W. F. Davis Machine Tool Co., New York
MOSCHETTI, RICHARD L., Mechanical Draftsman, Public Works Department, Navy Yard, New York
OHNSTRAND, ENOCH, Chief Engineer of Construction, Library Bureau, Ilion
PLAIN, MORSE D., Power Engineer, Syracuse Lighting Co., Syracuse
ROBBINS, GERALD G., Chief Draftsman, Shepard Electric Crane & Hoist Co., Montour Falls
SCHWEIGERT, WILLIAM F., Traveler, Niagara Machine & Tool Works, Buffalo
SEAMAN, FRANK W., Chief Engineer, Edward R. Ladew Co., Glen Cove
SELDEN, WILLIAM H., Chief Estimator, American Car & Foundry Co., New York

**Ohio**

BJOERN-CALLESEN, WILLIAM, Chief Draftsman, Development Department, Firestone Tire & Rubber Co., Akron
DAVISON, CHARLES M., Assistant Engineer, The Edwards Manufacturing Co., Cincinnati
DYKSTRA, JOHN E., Superintendent, Foos Gas Engine Co., Springfield
EVANS, FREDERICK H., Dean, College of Industrial Science of Toledo University, Toledo
UNVERFERTH, CLARENCE B. D., Chief Draftsman and Surveyor, County Surveyor's Office, New Court House, Dayton

**Oklahoma**

LANEY, LEON K., with Jordan, Laney & Nickel, Bartlesville
PETERSON, FRANKLIN P., Petroleum (Gas) Engineer, Frank P. Peterson & Co., Tulsa

**Pennsylvania**

De LAPOTTERIE, Harry, Works Manager, Townsend Co., Vice-President Metal Patents Co., New Brighton
GUCKER, FRANK T., Secretary and Treasurer, The John T. Dyer Quarry Co., Philadelphia
JONES, ALFRED, Superintendent, Armstrong Cork Co., Linoleum Department, Lancaster
LEECH, EDWARD, Construction Engineer, Barrett Co., Frankford
McKENNA, ROY C., President, Vanadium-Alloys Steel Co., Latrobe
WASILKOWSKI, FELIX J., Mechanical Engineer, David Lupton Sons Co., Philadelphia
WERTHEIM, FERD E., Production Engineer, Bonney Vise & Tool Works, Inc., Allentown

**Rhode Island**

GUILLEMETTE, JOSEPH D., Assistant Engineer, Warren B. Lewis, Providence

**Tennessee**

BEUTNER, VICTOR, Consulting Engineer, Knoxville

**Wisconsin**

JOHNS, EDWARD F., Assistant Engineer, Bayley Manufacturing Co., Milwaukee

**Canada**

DENTON, LOUIS I., Light, Heat & Power Engineer, Canadian Explosives, Ltd., Montreal
McCOY, LLOYD, Engineer on Special Work, Canadian Car & Foundry Co., Montreal
WARK, THOMAS A., General Superintendent, St. Maurice Paper Co., Cap Madeleine, P. Q.

**Philippine Islands**

SUZARA, AUGUSTUS, Boiler Inspector, Bureau of Customs, Philippine Government, Manila

**Russia**

JANOUSHEVSKY, PAUL, Chief Engineer Motive Power, Vladicaucase Railway, Petrograd

FOR CONSIDERATION AS ASSOCIATE OR ASSOCIATE-MEMBER

**California**

FAKKEMA, R., Draftsman, Holt Manufacturing Co., Stockton

**Connecticut**

STUART, CHARLES J., Mechanical Engineer, Footwear Division, U. S. Rubber Co., Naugatuck

**Massachusetts**

COYLE, WILLIAM T., Secretary and Mechanical Engineer, Deane Machine Co., Fitchburg

**New Jersey**

COUCH, FREDERICK F., Assistant Professor Mechanical Engineering, Rutgers College, New Brunswick

**New York**

BUTLER, RICHARD E., Engineer, The Babcock & Wilcox Co., New York

**North Carolina**

HEISKANEN, JALMAR E., Mechanical Engineer, The Champion Fibre Co., Canton

**Virginia**

LANCE, CLARENCE C., Shop Engineer, Seaboard Air Line Railway Co., Portsmouth

**Dominican Republic**

TRUEBA-SUAREZ, BENIGNO, Contracting Engineer, Erecting Sugar Factory, Central Las Pajas, Macoriz Sugar Co., San Pedor de Macoriz

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

**California**

KNAUER, HENRY S., Assistant Engineer of Tests and Chief Draftsman, Southern Pacific Co., Los Angeles

**Connecticut**

HERRICK, EDSON P., Cost Accountant, Colt's Patent Fire Arms Mfg. Co., Hartford
MacBEAN, ROBERT A., Industrial Engineering Staff, Winchester Repeating Arms Co., New Haven

**District of Columbia**

YOUNG, Ross H., Squad Chief, Mechanical Designer, Stone & Webster Co., Washington

**Illinois**

MEYER, LESLIE C., Mechanical Engineer, W. A. Jones Foundry & Machine Co., Chicago

**Iowa**

WILDER, MORRIS B., Industrial Engineer, Sioux City Gas & Electric Co., Sioux City

**Massachusetts**

GABELER, WILLIAM H., Assistant Superintendent, Barrett Co., Everett
HORTON, WILLIAM G., Turbine Tester, General Electric Co., Lynn
KING, HARRY H., Mechanical Engineer, Scovell, Wellington & Co., Boston

**New Jersey**

GREGG, LOUIS D., Vice-President, The Gregg Co., Ltd., Hackensack

**New York**

BEVIN, VICTOR D., Shop Superintendent, United Filters Corp., Brooklyn
EVERITT, Commercial Engineering Department, New York Telephone Co., New York
JAMISON, GEORGE S., Engineer, Underwriters' Bureau of the Middle & Southern States, New York

**Pennsylvania**

TADDIKEN, ULRICH A., Engineer, Condenser Department, Westinghouse Electric & Manufacturing Co., Pittsburgh
ZIMMERMAN, JAMES J., Inspector and Expeditor, Engineering Equipment, Mechanical Engineering Dept., Cambria Steel Co., Johnstown

**Texas**

MURPHY, EUGENE A., Instructor Technical Courses, U. S. Signal Corps, Ground Officers Training School, San Antonio

FOR CONSIDERATION AS JUNIOR

**Alabama**

MILLER, LEWIS H., Mechanical Engineer, The Tennessee Coal Iron & R. R. Co., Birmingham
MULLER, JACOB F., JR., Assistant Secretary, Assistant Treasurer, United Gas & Electric Engineering Corporation, Birmingham

**California**

KARSTENSEN, ALVIN M., Tool, Die and Machine Designer, Bethlehem Shipbuilding Corporation, San Francisco

**Colorado**

HARRISON, HORACE L., Draftsman, Dorr Co., Denver
LUNDQUIST, JOSEPH M., Assistant Chief Engineer, River Smelting & Refining Co., Florence

**Connecticut**

JONES, VINCENT L., Assistant Engineer, New York, New Haven & Hartford R. R. Co., Cos Cob
TAFT, EDGAR W., Statistical Engineer, Winchester Repeating Arms Co., New Haven
WARNER, RALPH M., 1st Lieutenant Ord. Department, U. S. R., Union Metallic Cartridge Co., Bridgeport

**Delaware**

HOMEWOOD, GEORGE M., Junior Mechanical Engineer, E. I. du Pont de Nemours & Co., Wilmington

**District of Columbia**

McCREA, CHARLES L., Ensign, U. S. N. R. F., Bureau of Ordnance, Navy Department, Washington
SANDMANN, WILLIAM F., Aeronautical Mechanical Engineer, Signal Service at Large, Washington

**Illinois**

KAHN, I. F., Assistant, Turbine Department, General Electric Co., Chicago
REED, MELBOURNE O., Junior Engineer, Cooley & Marvin Co., Chicago

**Indiana**

CROOK, WILLIAM R., Chief Designer & Superintendent of Factory Building, Aerothrust Engine Co., La Porte

**Kansas**

ROBERT, JULES H., Instructor, Department of Applied Mechanics and Machine Design, Kansas State Agricultural College, Manhattan

**Maine**

CHADBOURNE, JOHN L., with Portable Steam Saw Mill, North Berwick

**New Jersey**

ANTOSCH, WALTER, Engineer, Standard Aero Corporation, Elizabeth
BARRY, JOHN L., JR., Engineer, Standard Aero Corporation, Elizabeth
COLDWELL, CLARENCE B., Sales Engineer, Voorhees Rubber Manufacturing Co., Jersey City
SMITH, HARRY R., Testing Engineer, Hyatt Roller Bearing Co., Newark
THIERINGER, HERMAN, Production Department, Babcock & Wilcox Co., Bayonne

**New York**

BROWNELL, FREDERICK J., Mechanical Designer, Western Electric Co., New York
BUCHHAGEN, WALTER H., Experimental Engineer, J. P. Devine Co., Buffalo
EPPS, FRANK A., Chief Mechanical Engineer, Foamite Fire Extinguisher Co., New York
HEIDE, GEORGE F., Field Engineer, Construction Div., Interboro Rapid Transit Co., New York
HOLDEN, EDWARD A., Assistant Engineer and Draftsman, The Engineer Co., New York
LANDT, JAMES L., Assistant to Mechanical Engineer, Semet-Solvay Co., Syracuse
LAUTZ, EDWARD G., Mechanical Engineer, Assistant to the President, Niagara Machine & Tools Works, Buffalo
LOCKE, CHARLES A., Head of Mechanical and Electrical Detailing, E. F. Terry Manufacturing Co., New York
MERRILL, S. CLIFFORD, 2nd Lieutenant, Ordnance Reserve Corps, U. S. R., c/o National Envelope Co., New York
PARKER, KARR, Chief Engineer, McCarthy Bros. & Ford, Buffalo
PRIDDY, BENJAMIN E., Assistant Service Manager, Cameron Machine Co., Brooklyn
SILBER, ALFRED A., Draftsman, Perin & Marshall, New York
WEISS, PAUL A. H., Assistant Engineer, Central Hudson Gas & Electric Co., Poughkeepsie

**Ohio**

PARKER, GEORGE C., Assistant Chief Draftsman, Cincinnati Ball Crank Co., Cincinnati
SINNIGE, CARL E., Engineer, Plant Engrg. Dept., The Lodge & Shipley Machine Tool Co., Cincinnati

**Pennsylvania**

BLUM, MAYER I., Mechanical Draftsman, Stone & Webster Engineering Corporation, Philadelphia
JENSEN, JAMES A., Mechanical Engineer, Quaker City Iron Works, Philadelphia
SHUTT, JAMES M., Designing Draftsman, Arthur Brock, Jr., Philadelphia

**Rhode Island**

OWEN, RICHARD L., Draftsman, Brown & Sharpe Manufacturing Co., Providence

**South Carolina**

SLOAN, PEARSON H., Mill Engineer, J. E. Sarrine Co., Greenville

**Virginia**

THEE, WALTER C., 2nd Lieutenant, Coast Artillery Corps, U. S. A., Fortress Monroe

**China**

HARKNESS, HAROLD W., Professor, Shantung Christian University, Shantung

**Japan**

NEDDERMANN, THEODORE J., Mechanical Engineer, Messrs. Sale & Frazar, Tokyo

APPLICATIONS FOR CHANGE OF GRADING

PROMOTION FROM ASSOCIATE

**Wyoming**

GRATIOT, JAMES T., Manager, Coliseum Garage Co., Casper

PROMOTION FROM ASSOCIATE-MEMBER

**Alabama**

ROUSSEAU, EDWIN H., Chief Engineer, Engineering Department, Birmingham Machine & Foundry Co., Birmingham

**Massachusetts**

STALEY, ALLEN C., Research Engineer, Stanley Motor Carriage Co., Newton

**Ohio**

HILMER, OTTO E., Engineer, Walter G. Franz, Construction Engineer., Cincinnati

PROMOTION FROM JUNIOR

**New York**

KENT, HERBERT S., Chief Draftsman, West India Management & Consultation Co., New York
OATMAN, PAUL B., Mechanical Engineer, Modern Tool Co., New York
TYLER, HAZEN G., Assistant Professor of Mechanical Engineering, New York University, New York

**Ohio**

EINIG, ALVIN B., Machine Tool Salesman, Motch & Merryweather Machinery Co., Cleveland
SANDERSON, O. W., Director of Labor, The B. F. Goodrich Co., Akron

**Pennsylvania**

YODER, JACOB H., Supervisor of Apprentices, Penn. R. R., Lines East of Pittsburgh, Altoona

SUMMARY

| | |
|---|---|
| New applications | 157 |
| Applications for change of grading: | |
| Promotion from Associate | 1 |
| Promotion from Associate-Member | 3 |
| Promotion from Junior | 6 |
| Total | 167 |

# EMPLOYMENT BULLETIN

***THE SECRETARY considers it a special obligation and pleasant duty to make the office of the Society the medium for assisting members to secure positions, by putting them in touch with special opportunities for which their training and experience qualify them, and for helping anyone desiring engineering services. The Society acts only as a clearing house in these matters.***

*In forwarding applications, stamps should be enclosed to transmittal to advertisers; applications of non-members should be accompanied by a letter of reference or introduction from a member, such reference letter to be filed with the Society.*

## GOVERNMENT REQUESTS

*The Society has been asked to make suggestions of men for the following positions with the Government. Non-members possessing the necessary qualifications may avail themselves of these notices by enclosing with their reply a personal introduction to the Secretary.*

STAFF OF FIFTY MEN for the equipment division of Signal Corps, in connection with contracts for motors and airplanes, to handle detail work of passing on material and labor costs and quantity of both material and labor entering into work. Must have good general education and sound judgment, technical, manufacturing and accounting experience, with personal qualities which will command confidence and respect; must be capable of taking general charge of work and acting as chief of Section when latter is absent. Approximately three men will be stationed at each factory who will report to Finance Department in Washington. Best man of each group will be commissioned and given charge of special work at each point. 2475(a).

TRAVELING LABOR INVESTIGATOR, analyst of labor costs and conditions to improve and unify labor problem among contractors. May be commissioned. 2475(b).

TRAVELING MATERIAL INVESTIGATOR, to help in reducing waste of material and capable of readily locating and pointing out excessive costs. May be commissioned. 2475(c).

SPECIAL TOOL AND FIXTURE INVESTIGATOR, to travel between plants and assist in saving expense by unification of tool, jig and fixture work, capable of assisting contractors to find outside capacity where necessary due to lack of capacity in their own plants, and capable of passing upon cost of work, for Finance Department. Will probably be commissioned. 2475(d).

THREE ASSISTANTS in main office at Washington, who will be commissioned and assume charge of intelligent compilation of reports sent in by field force. 2475(e).

It is desired to have all of the men recruited for this work above the conscription age, to insure the permanence of the organization.

DRAFTSMEN on heating and plumbing, to go to France. 2476.

1. LABORATORY INVESTIGATION and testing of airplane instruments. 2477.
2. MECHANICIAN on same. 2477.
3. RESEARCH ENGINEER in physics. 2477.

DRAFTSMEN-DETAILERS on ordnance. 2507.

HIGH-GRADE MECHANICAL ENGINEER experienced in freight handling and conveying work, design and building local ports for munitions. Major's Commission. In U. S. 2527.

CIVIL ENGINEER, designer of buildings and docks. Major's Commission. In U. S. 2528.

EXPERIENCED CONSTRUCTION MEN, power houses and coaling facilities. Major's Commission. In U. S. 2529.

POWER HOUSE DESIGN AND CONSTRUCTION MEN. Captain's commission. Later appointment of one man in charge of completed ports. In U. S. 2530.

STATISTICAL ENGINEER AND ACCOUNTANT; as chief statistical and estimator for construction work in U. S. 2531.

## POSITIONS AVAILABLE

PHYSICISTS, ENGINEERS, DESIGNERS AND DRAFTSMEN for work of research, development, and design related to problems of telephonic, telegraphic and radio communication which are matters of public importance, required by the Western Electric Company, Inc. Both temporary and permanent positions open. Apply by letter, not in person unless so specifically requested, to F. B. Jowett, Chief Engineer, 463 West Street, New York City. 2178-AA.

TECHNICAL GRADUATE having three or four years' practical experience in efficient operation of boilers and stokers wanted for position of traveling engineer. Exceptional opportunity for man with initiative and ability to become expert combustion and steam engineer. Work requires extensive traveling in connection with investigation of power plants throughout country. 2340-AA.

YOUNG ENGINEER to take up safety work in connection with plant in New England and to take general charge of building inspection. 2438 (a)-AA.

CHIEF CHEMIST in connection with investigation work involved in manufacture of product. 2438 (b)-AA.

MECHANICAL SUPERINTENDENT. Must be competent to handle and direct construction, installation and maintenance of buildings, machinery and equipment, also power-plant operation. Jurisdiction will cover several plants. Only high-calibered men need apply. Outline fully past experience, age, salary, credentials. 2440-AA.

OPERATING ENGINEER for industrial plant. Must be technical graduate, have had practical operating experience in power plants and be capable of handling power proposition involving approximately 5000 boiler h.p. State age, experience in detail and salary expected. Location vicinity of Chicago. 2445-AA.

MECHANICAL ENGINEERS for permanent positions with established firm of consulting engineers. Young men, not liable to early army-draft call preferred, but age not necessarily deciding factor. No special technical experience necessary, but must have good technical education upon which to build. Good opportunity for men now in other lines, who wish to enter consulting field. Reply in own handwriting, stating education, experience, age, weight, height, nationality, and salary expected at start. Location New York City. 2446-AA.

ENGINEER AND DRAFTSMAN familiar with power-plant work and general piping. Good future for young man interested in general steam engineering in large manufacturing plant. Stage age, experience and salary expected. Location Philadelphia. 2448-AA.

EXECUTIVE POSITION in purchasing department of firm manufacturing tires and sundries. Location New England. 2457-AA.

EXPERIENCED DESIGNER on small machinery and tool work, with small and growing concern building machinery for canning industry. Location Maryland. 2458-AA.

YOUNG MECHANICAL ENGINEER who has not yet passed beyond the point of doing installation work of light machinery, and who may wish to develop in salesmanship. Location New York. 2461-AA.

PRODUCTION ENGINEER with practical experience in manufacturing line. Prefer man familiar with brass foundry practice, as well as small parts for automobile manufacture. Location New Jersey. 2463-AA.

YOUNG ENGINEER for testing. State experience, references, and salary wanted. Location Pennsylvania. 2467-AA.

YOUNG GRADUATE in mechanical or electrical engineering for drafting and estimating work in connection with blast furnaces and mines. Location East Tennessee. 2468-AA.

ENGINEER WORKS MANAGER, experienced man in shop principles and management, good executive and capable handler of men. Location West Virginia. 2470 (a)-AA.

SUPERINTENDENT assistant to above, practical shop man. 2470 (b)-AA.

ASSISTANT MECHANICAL ENGINEER, to pass on mechanical features of design, as strength of bases, shafts, sizes of bearings for particular duty and similar questions. Location New Jersey. 2471-AA.

ENGINEER, experienced in steam-power station design, operation and efficiency. Location New York City. 2472-AA.

ENGINEER, experienced in power-station construction, must be familiar with modern steam-power station construction and operation. Location Ohio. 2473-AA.

GAS ENGINEER, experienced in small municipal gas plants, on construction, operation, and efficiency. Must be familiar with standard practice and system ordinarily in use. Location New York and Ohio part time in each place. 2474-AA.

COLLEGE GRADUATES, ENGINEERS. Men out at least a year for general shop-engineering work with growing concern. Work leads to industrial management. State full particulars. 2478-AA.

MECHANICAL ENGINEER, technical graduate, one who has had experience in stoker business preferred and experienced in answering technical correspondence. Good opportunity for right man. Location Chicago. 2479-AA.

YOUNG A-1 TIME-STUDY MEN, connected directly with general manager's office, large rubber plant; only high-grade men with strong sense of proportion and natural ability need apply. Salary commensurate with achievement. Location Ohio. 2480-AA.

CHIEF DRAFTSMAN, qualified to handle position in connection with aeroplane designing, working under chief engineer. Location Cleveland. 2482 (a)-AA.

A-1 TOOL AND FIXTURE DESIGNERS. Location Cleveland. 2482 (b)-AA.

DRAFTSMEN to lay out and arrange equipment to get both efficient utilization of floor space and economical plant operation, have sufficient electrical knowledge to make drawings of electric light and power systems required by electricians. Only reliable, experienced, persons wanted. Excellent opportunity for advancement with possibility of being placed in charge of entire drafting room. Plant manufacturys nitric, sulphuric and muriatic acids, barium products, aniline dyes, dry colors, printing and lithographic inks and supplies, paints and varnishes. Salary to start $1200. Location Ohio. 2487-AA.

CHIEF ENGINEER versed in refrigeration and producer-gas engines. Salary $2400 to $3000 a year. Location 50 miles from Baltimore. 2488 (a)-AA.

EXPERIENCED DESIGNER familiar with automatic machinery, adding machines, etc., must be capable of developing complete design from "freehand sketches." Permanent position open with concern at present doing important government work. Salary to start $40 to $50. Location New York City. 2491-AA.

SWITCHBOARD OPERATORS who have had experience in large stations, preferably young men with good education who can qualify for responsible positions in this line of work. Location Ohio. 2492 (b)-AA.

ENGINEERING EDITOR to take responsible charge of monthly periodical in automotive engineering field. Should have broad engineering training. Man with experience on high-class technical periodical preferred. State salary, education and experience, and enclose samples (which will be returned) of technical articles written or prepared for publication. Location New York City. 2493-AA.

GRADUATE ENGINEER capable of learning part of business for large industrial company, with view to taking charge of department. Previous experience unnecessary, but ability and energy essential. Location New Jersey. 2495-AA.

ASSISTANT MANAGER for engineering department of Brooklyn concern. Man best fitted for position would be one having experience along general metal-manufacturing lines, especially machine-shop and sheet-metal stamping work. American citizen only considered. Duties are to have active charge of making up plans and estimates for new work. 2496-AA.

SUPERINTENDENT for road-making-machinery plant, consisting of machine and erecting shops, boiler and forge shops, foundry and wood working shop. Want man who has made good in similar position, of real executive ability, organizer and one who can handle men with the necessary push to drive job along. Salary to start $2500. Location New York State. 2497-AA.

STEEL SALESMAN not subject to military draft wanted by old-established steel house for permanent position. Give experience and full details in first letter. Location New York City. 2499-AA.

PRACTICAL MAN to take charge of laboratory. Should possess qualifications of engineer of tests as well as being practical man to handle foundry problems. Location Illinois. 2500-AA.

DRAFTSMEN familiar with designing and detailing machinery for economical production of farming machinery, automobiles, and pumps. Experience on cotton-gin and oil-mill machinery desirable but not essential. Must have some knowledge of shop and foundry practice. Salary depends on man. Location Georgia. 2503-AA.

ASSISTANT SUPERINTENDENT for shop making hydraulic forgings for 6, 8 and 9½ in. howitzer shells. Must be hustler and have practical experience along mechanical lines and ability to handle men. Need not be experienced forge man. Compensation dependent upon ability. Location Middle West. 2509-AA.

MAN for boiler-room efficiency work, where principal duties will be to make flue gas analyses, get coal and ash samples, inspect equipment, and observe all boiler-room operations, with view to making improvements. Previous experience not required. Salary $90 to $100, with good opportunity for energetic man. Location Ohio. 2510-AA.

SALES ENGINEER OR MACHINERY SALESMAN with good technical training, able to develop sales end of business in American machinery in France, with headquarters in Paris. Knowledge of French preferred, but not necessary. Man of 30 to 45 preferred. Must have actual sales experience, preferably in following lines: machine tools, power plant and electric equipment, including oil engines, road-making machinery, and mining machinery. Location New York City. 2511-AA.

MANUFACTURER of engineering specialties, large eastern firm, long established, desires young man not under 30, with technical education, good personality, and initiative. Knowledge of heating, ventilation, and power-plant engineering and installation practice essential. Excellent opportunity provided for development and promotion for right man. In letter give full particulars and experience and salary expected. Location New Jersey. 2512-AA.

HIGH-CLASS ENGINEER, with engineering, as well as executive ability, to take charge of engineering department. Man capable of looking after generation of power, particularly, but who will also have charge of plant maintenance, construction of new building, and, in general, supervision of machine departments. Location Ohio. 2513-AA.

EXPERIENCED MAN to take full charge of production problems of Connecticut concern; young man who has qualifications essential to handling problems of production with success. 2515-AA.

ASSISTANT SUPERINTENDENT for factory manufacturing fire-extinguisher equipment. Organization employing both men and women. Man slightly over draft age with several years' practical experience. Technical training preferred. Headquarters New York. Salary depends on man. 2516-AA.

INSPECTOR for factory manufacturing small brass parts. Man over draft age, capable of taking charge of department. Salary to start $30. Location New York City. 2519-AA.

DRAFTSMAN for work on wide range of designing machinery for roofing manufacture, conveying, foundations and plant layout. Location New Jersey. 2504-AA.

DRAFTSMAN, mechanical and electrical experience, and familiar with conveying machinery or designing of similar type of machinery. Location New York City. 2518-AA.

## MEN AVAILABLE

MECHANICAL ENGINEER or SUPERINTENDENT. American with 14 years' practical and theoretical experience. Specialist in steam, air, gas, oil and water engineering specialties. Machines, tools, fixtures and shop equipment, shop maintenance, efficiency, engineering testing and production engineer. Executive who can go into shop and do things. Successfully held positions involving above. At present employed. Salary $3000. A-1.

CONSTRUCTION SUPERINTENDENT. American, age 30. Technical-school graduate. In charge of large plant construction for last eight years, responsible for labor, ordering of materials, quality and progress of work. Desires responsible position with growing manufacturing company. A-2.

EXECUTIVE MECHANICAL ENGINEER, master mechanic, construction superintendent or chief draftsman. Member, technical graduate, married, aged 35, with several years' high-grade commercial experience and sixteen years' varied engineering experience in design construction and operation of manufacturing properties. Broad experience on material handling and power-transmission machinery, shop layouts, equipment and operation, with considerable experience in their construction. Can design, supervise, install, organize and produce in field of ordinary metal manufacturing, comprising pattern, foundry, forge, structural and machine-shop departments. Broad technical knowledge, energetic and industrious, executive and administrative ability. Available immediately. About $4000. Correspondence solicited. A-3.

PURCHASING ENGINEER OR EXECUTIVE. Graduate mechanical engineer, 30, married, clean cut, aggressive, and with capacity for work. Has moved up to position of purchasing engineer and general-office executive with young company doing million-dollar business. Wishes change in position. Michigan preferred. A-4.

ORDNANCE ENGINEER. Member with broad experience in design, construction and testing of machine, automatic, semi-automatic and rapid-fire guns, mounts, and ammunition of all kinds. A-5.

MECHANICAL ENGINEER, Columbia graduate, 1912, desires position as assistant to executive or consulting engineer. Broad general engineering experience, including industrial-plant layouts, machine design, inspection, construction, etc. Salary $4800. A-6.

MECHANICAL ENGINEER OR ASSISTANT TO EXECUTIVE. Member, 39, Cornell graduate, with advanced engineering degrees. Fifteen years' experience in estimating, designing, construction, development of processes, operations and office work, also considerable knowledge of munitions. Would like to change position and secure permanency if possible with some firm now engaged in war work. A-7.

CHIEF DRAFTSMAN OR ASSOCIATE CHIEF ENGINEER. Associate member, 28. Employed as chief draftsman of tube company. Desires change offering larger possibilities with future. Experienced in mechanical and structural engineering, also efficiency engineer, designing, estimating and erection. Complete tube plants, rod, wire, billet, skelp, rail and steel mills. Acid and zinc plants,

by-product coke-oven plants. Steel-mill buildings and bridge design. Best references, desires permanent position. Salary to start $200. A-8.

SUPERINTENDENT. Member, graduate, mechanical, 1904, large western university engineering school. Fifteen years' practical experience along mechanical lines, machine-shop practice, pattern making, foundry practical and efficient production methods. Thoroughly familiar with Taylor system of organization and bonus or piece-rate system of labor rates. Would invest. Location Chicago. A-9.

EXECUTIVE, assistant to executive or mechanical engineer. Cornell graduate, 36, 12 years' experience in positions covering chief executive, office management and works manager, operation, construction and experimental work. Experienced in combustion, steam and gas power, gas manufacture. At present employed. A-10.

MECHANICAL ENGINEER, technical graduate, desires position as assistant engineer or chief draftsman of machine company. At present employed as designer, estimator, and testing engineer. Experience includes testing, machine and structural design, office engineering, machine-shop and steel-foundry practice. Location Middle of Far West preferred. A-11.

CONSTRUCTION ENGINEER OR WORKS ENGINEER, member, technical graduate, 36. Fourteen years' experience, in charge of engineering department and assistant to construction engineer. Is thoroughly experienced in designing of blooming, billet, rod and strip mills, merchant mills, etc., also complete wire-mill plants. At present employed. A-12.

FRANCE, sales, investigational or executive services offered by American graduate, M.E., 37, formerly resident in France and speaking the language fluently, at present earning about $4000; but seeking position with better future prospects. Machine and erecting-shop, drafting and designing-room, as well as executive and sales experience in both building and mechanical fields. French and American references. A-13.

MECHANICAL ENGINEER, 33, 11 years' estimating, designing and shop experience on boilers, superheaters, stokers and oil burners; also with heating, ventilating and air conditioning, desires position as chief draftsman or assistant to chief engineer or manager of progressive concern, where conditions allow development of ability. Location New York or Brooklyn preferred. A-14.

MECHANICAL ENGINEER with 15 years' experience in the design of power plants, industrial plants, heating, ventilation, etc. Has had charge of men and shown executive ability. At present holds responsible position but has very little work to do. Willing to consider responsible and permanent position only. A-15.

ASSISTANT TO SUPERINTENDENT OR PLANT ENGINEER. Cornell graduate, American, 35, with 13 years' experience in engineering department of both manufacturing and metallurgical plants, desires position with prospects of permanency and advancement. A-16.

MECHANICAL ENGINEER, member, 39, American, 22 years' experience on automatic machinery, automatic press tools and deep drawing-press work, 12 years' experience in Connecticut brass shops. Shall soon finish seven-year contract with present employers. Can design, supervise, organize or install new work as mentioned above. A-17.

MECHANICAL ENGINEER, associate member, 15 years' experience in consulting, designing, machine-shop, laboratory work, superintending coistruction and with general high-grade mechanical-engineering experience desires position where economical developing ability of patents and research work is required. Prefer Middle West, South West or West. A-18.

DIESEL ENGINE EXPERT desires to communicate with some concern, having the capital and willing to go into development of Diesel-engine business. Advertiser, now employed, has had broad engineering experience and knowledge of how to obtain real efficiency. Communications to be confidential. A-19.

ENGINEER AND SUPERINTENDENT. Successful in manufacture of high-explosive shells and tools for machining, nosing and finishing shells. Will consider any proposition along these lines for patriotic and personal reasons. A-20.

HEATING AND VENTILATING ENGINEER, M.E. graduate, American, 36, married. Seven years' experience in heating and ventilating engineering, both design and construction, experience in refrigeration and other lines of engineering. Sober, energetic and ambitious. Has reached limit of advancement with present employers. Prefers position in charge of work as assistant to chief engineer. Salary $3000 to $3500. Available February 1, 1918. A-21.

CHIEF ENGINEER OR MECHANICAL SUPERINTENDENT under 40, with technical education and sixteen years' experience in design, construction, and equipment of industrial buildings and power plants, now with large corporation, desires connection where organization and executive ability combined with engineering experience will command fair salary. A-22.

MECHANICAL ENGINEER, Columbia graduate, 1902. Has served in railroad-motive-power department for number of years. Desires position as mechanical engineer or engineer of tests on railroad or in a line of business related to railroading. At present employed. Salary expected, $3000. A-23.

YOUNG MECHANICAL ENGINEER desires position as assistant general superintendent, production manager or superintendent of equipment of large plant or general manager of small plant. Has successfully held above positions and also worked in machine shop and drafting room. Capable executive, thoroughly practical, aggressive and of generous build. Has specialized on production work, having full charge of designing and building equipment to produce wide range of articles of wire, sheet metal, wood, paper, etc., also designed and installed equipment for processing, assembling, conveying and labor saving. Understands cost accounting, estimating, rate setting, time study and routing; 28 years old, with family. Exempt under federal draft. At present employed. Salary $3500 to $4000. Any location, prefer concern one of whose lines, at least, is of vital importance to Government at this time. A-24.

MANUFACTURING OR MECHANICAL EXECUTIVE. Age 44, at present holding position as superintendent. Desires to locate in Bridgeport, Conn. Experienced in machine-shop practice, and in manufacture of hardware, guns and ammunition. A-25.

TECHNICAL GRADUATE in mechanical engineering, 33, married, experience in factory planning and construction, design of special equipment, power-plant installation and maintenance, as well as organization and management, desires to make connection in executive capacity with progressive industrial enterprise. Location immaterial. Complete record with references available. Minimum salary considered $3600. A-26.

MANUFACTURING EXECUTIVE, 33, married. Thorough mechanical and modern management experience in manufacturing of small machines and sheet metal goods. Fifteen years' experience from apprentice, through tool-making, designing, foremanship, to position of management engineer with leading company for past 4 years. Practical, progressive, originating, and clean cut. Interested only in permanent position with greater opportunites with reliable company located in good home town. A-27.

EXECUTIVE OR ASSISTANT SUPERINTENDENT. Technical education, American, 36. Practical mechanic, familiar with design of special machinery, tools, jigs, fixtures, etc., for manufacturing duplicate parts on interchangeable system. Twelve years in drafting room, including chief draftsman; six years' shop experience, one as foreman. Salary $2000. Location preferred, Eastern States. A-28.

CHIEF ENGINEER OR MASTER MECHANIC, with thorough technical and practical experience, covering construction, operation and upkeep of steel plant, specialty metallurgical work, heating and melting furnaces. A-29.

SAFETY ENGINEER, six years' thorough technical and practical experience in this capacity, with large steel works in Pennsylvania. A-30.

METALLURGIST AND TESTING ENGINEER. Graduate mechanical engineer, 33, married, wishes to connect with reliable concern, whose product requires careful and thorough testing aid heat-treating of steels. Interested only in permanent position with good prospects. Seven years' experience in steel research work and heat-treating, successful in handling men. At present employed. A-31.

WORKS MANAGER OR GENERAL SUPERINTENDENT, desires connection with large plant, any product from automobiles to clocks; broad-gage, fully trained executive; 36; experienced in plant layout, best shop practice, management control methods, systems and man training; successful in all jobs through production, design and control divisions; man whose vision is equal to possibilities of business and accustomed to make plans become facts. A-32.

YOUNG MAN of proven ability, 9 years' practical experience in consulting engineering, contracting, sales engineering and technical editorial field. Specialist in mechanical and electrical equipments for power plants and buildings. Maintenance supervision, investigation, design and layout. A-33.

SUPERINTENDENT, MECHANICAL ENGINEER, or MECHANICAL DRAFTSMAN. Experienced in plant layout detail work, small machine design, rolling-mill machinery, installation of machinery and high-tension electric service, motors, generators, transformers, etc. Executive ability, can handle men. Machine shop practice and well experienced in furnace construction, annealing and melting type. Consider any position of technical nature. Graduate of Manual Training School and University in Mechanical Engineering, eight-year course. A-34.

# ENGINEERING SURVEY

## A Review of Engineering Progress and Attainment in Mechanical Engineering and Related Fields, Including a Digest of Current Technical Periodicals and Selected Titles of Engineering Articles

### War Service Boards

THE mobilization of the industries of the United States for war purposes—The War Service Conference—was brought about by the Chamber of Commerce of the United States at a meeting of the business men from all over the country held in Washington today. Addresses were made by W. S. Gifford, director of the Council of National Defense; Daniel Willard, chairman of the War Industries Board; Harry A. Garfield, Fuel Administrator; Geo. N. Peek, industrial representative of the War Industries Board, and others.

"It is not going to be any light task," Mr. Gifford said, "to completely organize industry in this country, but we think we are going to do it effectively, so that we may go ahead and have these new war-service committees of the Chamber tell the Government what can and what should be done. It is obvious that some industries are going to be more essential than others, but it would be foolhardy to think that the time will not come when the so-called less essential industries may not be needed."

Mr. Gifford spoke of the question of possible Government recognition of the War Service Committee.

"This is a Democratic formation of committees by the industries and not by the Government," he said.

A. C. Bedford, president of the Standard Oil Company, who has been chairman of the Council of National Defense Committee on Oil and Petroleum Products, told the committeemen of some of the difficulties his committee had experienced in endeavoring to aid in organizing the war.

"Nevertheless," he said, "we have not failed to supply any order which has been given to us either by our own or any foreign government."

Mr. Willard discussed the industrial end of the war. After saying that legislation by Congress will be necessary before the country can have a plan of one centralized control of purchasing, such as the British Ministry of Munitions, Mr. Willard said that because a ministry of munitions had been established in England, it does not follow that such a plan would be successful here. (*Journal of Commerce and Commercial Bulletin*, December 13, 1917, p. 3)

### 4500-Ton Concrete Ship for U. S.

'king in conjunction with the Bureau of Standards, the ..l States Shipping Board has decided to start the con..ruction of a concrete ship. A representative of the bureau returned today from San Francisco and reported favorably on a concrete vessel of 4500 tons which had been built there. The experiment by the Shipping Board will probably be begun shortly in one of the Southern yards, most likely in Georgia.

Announcement was also made by the board today that a Boston concern would build a concrete vessel of 3500 tons at its own expense, which would be turned over to the Shipping Board. If satisfactory, this firm will be awarded a contract for twenty more ships of the same size and type. This vessel will be constructed in a yard nearby that where the Shipping Board will try its experiment.

Hope is held out that the concrete ships which will soon be laid down will prove practicable, as the material involved is not required for any other section of the war program, and could be obtained without difficulty. Only a small amount of steel is needed for concrete ships, which have another advantage in that they can be speedily constructed. The time for completing a concrete hull is estimated at sixty days at the most. The vessels are expected to be capable of a speed of ten knots or greater.

Secretary Redfield today requested the Shipping Board to cooperate so far as possible with the Bureau of Standards. An inspector will probably be appointed for the Pacific Coast, and also for the South, with this idea in view. The Shipping Board may make an appropriation specifically for this work. (*Journal of Commerce and Commercial Bulletin*, December 13, 1917, p. 5)

### Naval Vessels in Commission

At the beginning of the fiscal year 1917, the monthly expenditures for all naval purposes were about $8,000,000; they are now about $60,000,000. On January 1, 1917, there were 300 naval vessels of all kinds in commission; today there are many more than a thousand. These typical figures sufficiently indicate the task the navy has had to accomplish to date in the way of expansion.

There was embarrassment in the early days of the war by reason of the patriotic and eager response of the young men of the country to the navy's efforts in recruiting. These were so successful that it was difficult with the then facilities to take care of the flood of volunteers. There were also various threats of epidemics of the diseases that appear when unseasoned men are suddenly assembled in large numbers. These, however, were stamped out, and facilities either completed or to be ready before winter are now adequate for the needs of the present navy personnel. If required, these can be enlarged even more rapidly after the experience now had. (*The Official Bulletin*, December 11, 1917, p. 10)

### Concrete Craft May Operate on Canals

The *Barge Canal Bulletin* for November, which makes a rather belated appearance, contains a hint that concrete craft may be seen on the canals during the coming summer. A review of the situation reads in part:

"During the intervening winter, if sufficient energy is exerted, the new craft for this traffic may be built and the old boats be made more suitable, but there must be no delay in beginning. It may happen, also, that the season will witness an innovation in the kind of boat. Many studies in boat building have been made recently by various engineers and naval architects, and the vessel constructed of reinforced concrete has not been overlooked. This type has the advantage of quick construction, and of being composed of materials which can be obtained easily and without interfering greatly with ordinary war supplies." (*Journal of Commerce and Commercial Bulletin*, December 15, 1917, p. 16)

## Change in Airplane Program

Recent rumors that the Liberty airplane engine had proved a failure are emphatically denied in official quarters in Washington. Unofficially, *The Iron Age* learns, however, that a decision has been reached to limit the use of the Liberty motor to scout duty and the time-tried French motors will be used on the battle airplanes used by the United States Government. In various ways the airplane plans of France and the United States appear to have been consolidated. "The French-American airplane program" is a phrase that is now frequently used in Washington.

The decision to use the Liberty motor for scout duty only is believed to have followed the criticism of French airplane experts that the United States in putting all its faith in the one motor was placing its eggs in one basket, and that if, under actual fighting conditions, the Liberty motor did not measure fully up to expectations, there would be nothing to fall back upon. The motors which the French and English have used most successfully in battle are the Renault, Gnome, Hispano-Suiza and the Rolls-Royce. It is now apparent that this Government will build a certain number of each of these motors in the United States. Contracts have recently been placed with American manufacturers for Renault and Hispano-Suiza motors and other contracts are pending. In addition, this Government will provide additional equipment for the French automobile plants which are making airplane engines and will also supply several thousand mechanics, who are now being recruited. The original program was to build only 5000 Liberty motors in France, but latest information is to be the effect that the United States will assist the French in building a large number of French and English engines as well.

An important step in the airplane program was the taking over by the Aircraft Production Board of the plant and equipment of the General Vehicle Co., Long Island City, N. Y., at a price said to have been fixed at $2,500,000. The General Vehicle Co. has been figuring for some time on a large contract for the manufacture of Gnome motors and had issued a list of about 900 machine tools to be purchased. The plant will probably be used by the Aircraft Production Board for experiments in airplane engine construction. (*The Iron Age*, vol. 100, no. 22, November 29, 1917, p. 1331)

## National Advisory Committee for Aeronautics

The last annual report of the Executive Committee of the National Advisory Committee for Aeronautics gives many interesting data on the activities of the Committee during the fiscal year 1916-1917. Naturally, some of the activities can be mentioned in only a summary manner, but the report, nevertheless, first shows that a large volume of important work has been performed.

In March 1917 the committee arranged, in conjunction with the National Research Council for representation on the Foreign Committee sent abroad by the National Research Council, to obtain detailed information on scientific matters of importance in connection with the war. Dr. Joseph S. Ames was appointed as such representative.

In October 1916 the committee took under consideration the question of the selection of a suitable site for its proposed experimental laboratory. In this study the committee acted in coöperation with a board of officers of the U. S. Army which had been appointed to inspect sites for the experimental station and proving ground of the War Department.

At the suggestion of the War Department requesting recommendation by the Advisory Committee in the matter, this committee inspected several proposed sites, and after making inquiries as to the general health conditions and the problems of accessibility to Washington and the larger industrial centers of the East, protection from enemy naval attack, climatic conditions, and cost of the site, it made recommendation to the War Department for the purchase of a site about four miles north of Hampton, Va., which recommendation was accepted by the War Department, and the site was purchased.

On this field the War Department has allotted to the committee a space suited to the erection of the committee's proposed research laboratories. The committee has designed the first building of the group contemplated, and the design has been approved by the architects for the War Department. Contract has been entered into with the J. G. White Engineering Corporation, New York City, for the erection of the laboratory at an estimated cost of $80,900. The laboratory building is now in the course of construction. At this laboratory the committee will carry on, in wide variety, research and investigation relating to aeronautic science, and including a study of planes in free flight. The committee has also under preparation plans for the first aerodynamic laboratory to be installed at Langley Field intended for the development of high wind speeds. The work on this laboratory will be begun as plans are ready.

The committee has coöperated with the Aircraft Production Board in connection with a wide variety of problems relating to the design, specifications, and tests of aircraft. The committee has now in hand (November 1917) a most important investigation on the use of steel for airplane construction, and is supervising the development of a design for construction in steel, to be later subject to a program of tests intended to show the possibilities of such type of construction.

In connection with the subject of the materials for airplane construction, the committee has given its attention chiefly to the investigation of strut forms for airplanes, the strength of spruce spars, and the development of cotton airplane fabrics as a substitute for Irish linen.

In the field of power-plant design and construction for aircraft, the committee has coöperated with the Bureau of Standards in the design, construction, equipment and operation of a large vacuum-chamber, engine-testing laboratory which is intended to reproduce the conditions of aeronautic engines operating at high altitudes. This equipment has been installed with special reference to the development and improvement of the Liberty engine and important investigations bearing on this problem are now being carried forward. The committee has also carried on a number of researches on the subject of radiator design and proportions, carburetor design and adjustment, ignition apparatus, and is continuing its study of the problem of an airplane engine muffler.

At the request of the War Department, the committee loaned one of the members of its technical staff for the supervision of tests on the first Liberty engines at Detroit, Pike's Peak, and elsewhere, to determine their mechanical and thermal efficiency and the power delivery of the engines at various altitudes.

The committee has undertaken important investigations relating to the development of various instruments used in the navigation of aircraft and in testing aircraft in free flight. In particular there has been developed an improved form of geographic position indicator which will be of special value in connection with certain free-flight tests under consideration.

Regarding the subject of aircraft communications, the committee has coöperated in the development of a generator for wireless sending from airplanes and intended to satisfy the requirements of the army and navy. Means for receiving wireless signals in an airplane have also been investigated, and it has been established that a very efficient receiving set employing the sound method is practicable; investigations are still being carried on regarding means for detecting hostile airplanes before they are visible or before they can be heard by the unaided ear.

On March 8, 1917, the committee took under consideration the development of methods for mapping from airplanes which should be rapid, economical and sufficiently accurate for aviation purposes. Allotments were made for developing a new type of airplane mapping camera, and gratifying progress has been made in the development of such an instrument. Before regular navigation of the air can be undertaken, it will be necessary to supply maps and to establish and suitably mark aerial routes and suitable landing places for the aviator. In certain sections of the country and through the generous coöperation of patriotic citizens interested in this work, gratifying progress has been made in these directions, notably between Dayton, Ohio, and Rantoul, Ill.

Soon after the declaration of hostilities with Germany, the Chief Signal Officer called to the attention of the committee the large amount of material which was coming before the War Department, comprising inventions and suggestions relating to aeronautics in warfare, and asked assistance in examining and disposing of such material. Accordingly, this committee, through an appropriate sub-committee appointed for the purpose, has acted as a board of inventions for the Government in matters relating to aeronautics, and since the outbreak of hostilities between the United States and Germany it has weekly examined hundreds of suggestions and inventions pertaining to this subject, and referred to it by the War and Navy Departments, in addition to the suggestions and inventions which come direct to the committee. This work has required a large amount of time and careful study, and has called for considerable increase in the technical and clerical staff of the committee in order to care for the very large amount of examinations, study, and correspondence with inventors regarding these matters. Several suggestions of value have been received and brought promptly to the attention of the particular Government office that was most directly interested.

During the year the committee has given further attention to the subject of the definition and standardization of technical terms used in aeronautics, and has prepared a further edition of its bulletin on the subject (Technical Report No. 15).

On recommendation of the Advisory Committee, in December 1916, the War, Treasury, Interior and Commerce Departments adopted the metric system of weights and measures for all drawings and calculations on aeronautical matters, for use with the accompanying English equivalents.

The committee has made progress during the year in the study and investigation of the following problems:

Stability as determined by mathematical investigation
Air speed meters
Wind sections
Aeronautical-engine design
Radiator design
Air-propeller design and efficiency
Forms of airplane
Radiotelegraphy
Non-corrosive materials
Flat and cambered surfaces
Terminal connections
Characteristics of constructive materials
Standardization of specifications for materials.

## First Machine-Made Liberty Engine

The first machine-made Liberty airplane engine was completed on Thanksgiving Day and a substantial number will be delivered this month. Production of Liberty airplane engines on a quantity basis has actually begun, while at the same time aviators are being graduated in large numbers from training schools here to immediately travel to the fighting lines in Europe. It may be authoritatively stated that the United States is within sight of realization of the great airfleet project mapped out since the date this country entered the war.

Figures cannot be published for obvious reasons, but it became known in Washington, following the return of members of the Aircraft Board from an inspection trip through the country, that these members are certain that another 60 days will witness men and machines being turned out at a rate insuring success to the original plans. Numerous tests have been made for power, gasoline consumption and for breakdown, and these have proven the engines to be even more powerful and efficient than was originally claimed for them. (*Automotive Industries*, vol. 37, no. 24, December 13, 1917, p. 1064).

## Exchange of Technical Information with the Allies

There has been a particularly frank and free interchange of naval and technical information between the countries with which we are allied and ourselves which has been of great value in view of actual war experiences abroad. Not only as to broad policies, but also with respect to details of construction and tactics we are in close touch. The "partnership of democratic nations" has thus already proved its efficacy in the conduct of naval war.

While the details of what have been done, and how we have done it, must wait until it is permissible to spread them upon public record, this summary may be given to our people: In the navy we have prepared for and have met the duties of the present; we are preparing for and are confident we will be able to meet any call for greater duties, for more exacting responsibilities. The best way to secure enduring peace is to prepare unceasingly, night and day, for the winning of the war. (From the annual report of the Secretary of the Navy, see *The Official Bulletin*, December 11, 1917, p. 11)

## Burn More Wood, Save Coal, Fuel Administration Urges

The Fuel Administration issues the following:

"The United States Fuel Administration, in coöperation with the Department of Agriculture, has inaugurated an intensive campaign for the substitution of wood for coal. The action is taken as a means of conserving the coal supply.

"In this connection it is announced that the Department of Agriculture will provide the services of expert foresters, who will supervise cutting of wood so that no damage may be done to growing timber, and that the largest use may be obtained of the supply of wood.

"One cord of hardwood is equal to a ton of coal, according

to the experts of the Fuel Administration. The Department of Agriculture and the Fuel Administration have statistics showing that there is a vast quantity of dead wood in many sections of the country, and that the supply in many communities is sufficient for domestic purposes. This wood, in many instances, is destroyed as waste." (*Official Bulletin*, November 30, 1917, p. 5)

## Enlistment of Students in the Technical Schools

The Provost Marshal General has sent the following telegram to the governors of all states:

"Section 151, Selective Service Regulations is amended by the addition of sub-paragraph D as follows:

"Under such regulations as the Chief of Engineers may prescribe, a proportion of the students, as named by the school faculty, pursuing an engineering course in one of the approved technical engineering schools listed in the War Department, may enlist in the Enlisted Reserve Corps of the Engineer Department, and thereafter, upon presentation by the registrant to his local board of a certificate of enlistment, such certificate shall be filed with the questionnaire, and the registrant shall be placed in Class 5 on the ground that he is in the military service of the United States." (*Official Bulletin*, December 11, 1917, p. 4)

# U. S. BUREAU OF STANDARDS

IN the investigation of building stones of the United States now being conducted at the Bureau of Standards, the tests of sandstones have been completed and work begun on the Indiana limestones with a view to grading as to quality and use. The special experimental freezing apparatus for testing the stone has been installed and is now ready to put into operation.

*Stresses on Floors.* Investigation is being made of working stresses and loads on floors built under the regulations of the Baltimore Code as compared with floors built under Government regulations. Preparations have been completed for the testing of three floors for the Bureau of Yards and Docks, Navy Department. These tests are to be made on concrete floors in warehouses located at New London, Conn., Charleston, S. C., and Hampton Roads, Va. It is anticipated that these tests will be made within the next few weeks. The results will afford an excellent opportunity for the investigation of flat-slab floor design, as the floors in question are designed by three different systems to carry the same live load.

*Cement Testing.* The amount of cement testing done by the Bureau of Standards has increased 800 per cent during the past month over the corresponding period twelve months ago.

*Steel Wheels for Motor Trucks.* A number of truck wheels were tested for the War Department, covering different makes of wheels. The wheels were submitted in pairs, each including a front and a rear wheel. The testing was done in a large 3,200,000-lb. Emery testing machine.

*Test of Stop Watches.* The Bureau has carried out tests on 1200 stop watches to determine their accuracy with a view to acceptance on contracts. Runs of 30 sec., 1 min., and 5 min. were made on each watch and a tolerance of 0.4 sec. was allowed. Only 10 per cent of the watches failed to pass the test, some for defective mechanism and the majority for exceeding the tolerance.

*Investigation on Cloth Tapes.* A comparative test of sample cloth tapes was made to determine which would be most suitable for use in rough measurements such as the measurement of hulls of vessels of the Steamboat Inspection Service. This test included determination of the errors of the tapes; the change in length with tension; the recovery of length after tension had been applied; the effect of moisture on the tapes in their original condition when new, and the effect upon these factors of wear upon the tape. To ascertain the latter, the tapes were run by means of a motor and idler pulley over a series of obstructions covered with sandpaper that removed part of the coating in a manner similar to what would take place in use. One of the tapes was a so-called metallic tape having several threads of metal tinsel running lengthwise of the tape. The other was a linen tape without such threads. The latter tape showed greater changes in the first part of the test and its surface was worn off more in the latter part of the test, resulting in greater exposure to the efforts of moisture and consequent shrinkage of the tape.

*Instruments and Methods.* A new profile device is being constructed from two discarded theodolites and a "last-word indicator," and will give errors in profiles without computation, thus making a great saving in time. Another important feature is the method of adjusting profiles, which separates the adjustments necessary for proper alignment to two definite motions.

*Short-Weight Mine Scales.* Note may be made of the successful conclusion of cases against mining companies in Maryland, inaugurated by the Grand Jury of Allegheny County, as a result of disclosures made by the Bureau after a test of nine scales in this region. One company was fined $900 and costs. Sentence was withheld in another case until the conclusion of negotiations between the miners and the company regarding the payment of back wages which have accumulated as a result of short weighing of coal mined.

*Infra-Red Spectroscopy.* During November the work on infra-red photography was continued. Data were collected which will enable the absorption lines in the solar spectrum to be classified as solar or terrestrial. The latter are due to the selective absorption of the earth's atmosphere. The spectra of iron and cobalt have been extended well beyond 10,000 Angstrom units or 1 μ, and the nickel spectrum has been photographed to 9700 A. The measurements of iron and cobalt spectra have been collected and the data are ready for publication. A preliminary report on the solar work has been sent to press and will shortly be available. An important development of this work is its application to military photography.

*Engineering Research.* A large number of engineering problems are being investigated by the Bureau, among which some typical examples may be cited: design of airplane thrust and torque dynamometer, investigation of aluminum struts, magneto couplings, arc-welded sheets for lifeboat construction, design of instrument for measuring tension in airplane cables, machine-tool investigation, investigation of structural columns, and many other problems of military importance where the subjects are of confidential character.

# NEWS OF OTHER SOCIETIES

## Society of Naval Architects and Marine Engineers

LOYAL support of the Government in the present crisis was pledged by the Society of Naval Architects and Marine Engineers at its annual meeting held in New York, November 15 and 16, and at the same time in a petition to the President of the United States an earnest plea was made for the appointment of a representative builder of merchant vessels as a member of the Council of National Defense, where other important industries engaged in war work are now represented.

Throughout the meetings, and at the annual banquet which followed and was addressed by the Secretary of the Navy, the general manager of the United States Shipping Board Emergency Fleet Corporation and representative shipbuilders, the difficulties which shipbuilders are now facing, arising from the shortage of labor, labor troubles and the urgent need of increased production, were constantly referred to. Two of the papers presented at the technical meetings dealt with various phases of the labor problem. The first described the service department which has recently been established at the Fore River shipyard, and which has proved so successful that the underlying principles on which it is based are now being extended to all shipyards of the country through the Industrial Service Department of the Emergency Fleet Corporation. The other paper, by Naval Constructor T. G. Roberts, U. S. N., analyzed the principles of industrial management, especially as applied to the organization of a shipyard. Still another phase of the labor question as applied to the manning of the emergency fleet was discussed in a paper on the Progress of Marine Engineering and the Education of Marine Engineers.

The effect of the war on ship design and construction was reflected in at least three papers. The first described the method of building fabricated ships, as developed by the Chester Shipbuilding Company, Ltd., and the Merchant Shipbuilding Corporation. The second gave the results of tests at the Government experimental tank in Washington on models of cargo ships with lines of simple form, where the ordinary ship sections are replaced by straight-line sections with rounded bilges. The results of these experiments led the author, Naval Constructor William McIntee, U. S. N., to the conclusion that cargo vessels can be built on simplified lines which will give practically as good results from the resistance standpoint as those built on the present conventional lines. If propulsive efficiency is also taken into account, it is believed that the simplified form will have, at least in certain cases, advantages over the present type. The third paper, by Robert W. Morrell, hull superintendent of the Standard Oil Company of New Jersey, outlined recent developments in tank-steamer construction, showing that the total tonnage of American tankers now in service represents about 20 per cent of the total American steel-vessel tonnage, exclusive of that on the Great Lakes, as against 10 per cent at the beginning of 1915. Previous to 1915, the average size of the modern tanker was 5200 tons, while at present it has increased to 9100 tons. Along with the increased size has come the development of the shelter-deck type of vessel, and a growing tendency to adopt a straight sheer line amidships. Special constructional features which have recently been developed are the adoption of the rolled tee-bar section for oiltight work and the use of the multiple punch. In closing, Mr. Morrell points out that as all of the tank vessels now under construction are for 1917-1918 delivery, and as the Shipping Board has failed to provide for any tank-steamer construction in its shipbuilding program, the building of tank ships will soon be at a standstill in this country, in spite of the fact that the transportation of oil is one of the greatest necessities in the war.

The submarine question was taken up in two papers, one by Naval Constructor E. S. Land, U. S. N., which discussed the relative advantages and disadvantages of single- and double-hull types of submarines, and the other by Marley F. Hay, which outlined the influence of the war on submarine policy and advocated a new type of submarine, designated as a contra-submarine, especially designed for offensive warfare against submarines.

Several papers dealt with various auxiliaries on board ship, one by Dr. K. Suyehiro of Japan, describing an ingenious device for comparing the rotation of shafts; another by H. L. Hibbard, reviewing the applications of electricity to various auxiliaries on shipboard, and a third by Elmer A. Sperry, giving the results of the application of gyro stabilizers on board ship for the prevention of rolling. Valuable data were also given by W. W. Smith in a paper on Wind and Fouling Resistance on the Naval Collier *Neptune*, as determined both by model experiments in the Washington wind tunnel and from the service performance of the vessel, and by Messrs. A. G. Mattsson and Thomas Durkin, in a paper giving power and economy tests of one of the most efficient ore carriers on the Great Lakes.

H. H. Brown.

## National Machine Tool Builders' Association

The Annual Meeting of the National Machine Tool Builders' Association was held at the Hotel Astor in New York on October 30-31.

The Machine Tool Builders' Association, composed, as it is, of the owners and the executive heads of machine-tool-building concerns, generally devotes its time more to the commercial than to the engineering side of the business. The session was marked by a very keen interest in present conditions. President J. B. Doan set the keynote in calling attention to the very important part that the machine-tool builders now play in the necessities of the Government. Followed, as this was, by a talk by Mr. Henry Japp, C. B. E., Deputy Director General in U. S. for British Minister of Munitions, the members and guests were still more impressed with the obligations resting upon them in the present crisis.

In an executive session, Mr. George E. Merryweather talked in a very intimate manner, and impressed by citation of actually existing conditions the necessity incumbent upon the machine-tool builder to urge forward work in this industry.

While there is no doubt but that the membership in all cases have been feeling the responsibility that is upon them at this time, yet this meeting impressed upon them more than ever that the greatest possible efforts that they could make would be needed to help improve conditions. Guns and ammunition are needed, and in large quantity, but before they can be produced to the extent that they should be, machine tools of nearly all types are wanted to produce them, and, as one speaker expressed it, while there might be a change in conditions later, today the machine-tool industry is the one that the manufacturers of all types are looking to to get out their production.

It is inspiring and helpful to participate in such a meeting

as this was—to see the response of men to the call when the necessities are visualized to them relative to their own businesses, and they respond with the purpose of doing not their "bit," but their whole.

The keynote of service that President Hollis struck at the time of installation into office last year, permeates not only the general engineering branches, but every branch of the service with which engineers and their co-workers have to do, and the complete printed report of this meeting, when it appears, will be well worth careful reading by all.

At the business meeting, J. B. Doan, of the American Tool Works Co., Cincinnati, was elected president.

W. A. VIALL.

## Catalogue Studies

Through the courtesy of Mr. George Francis Whipple, the United Engineering Society Library has received a complete set of the Catalogue Studies compiled by him, together with a bookcase for the fifty-five volumes comprising the set at present.

This work represents an attempt on the part of some one hundred and fifty manufacturers of technical merchandise to make their catalogues more useful for reference purposes than such publications usually are. The machine catalogue of today is an expensive and valuable book, useful not only as a price list of the manufacturer's products, but also frequently as a manual of current practice, and for its tables of various constants, formulae, etc. Many catalogues are distinctly valuable as textbooks for educational purposes. Nowhere else are the latest approved methods so promptly available in print.

This material has, unfortunately, not been easily accessible in the past. This is partly due to the form in which it is published, partly to the difficulty of separating the useful material from that of little relevance, and partly to the lack of any key or index to that portion which is worth while.

To remove these difficulties has been the object of Mr. Whipple and the firms represented in this collection. The valuable catalogues issued by these firms have been selected and assembled in fifty-four binders of convenient sizes. An additional binder contains blueprints, charts, etc.

## This Month's Abstracts

In the section Air Engineering a practical method is recommended for measuring air delivered by a turbo-blower; also the drop of pressure in compressed-air hose is discussed on the basis of tests carried out at the University of California.

An article on the hardening of aluminum bronze is indirectly abstracted from a German publication. It may be mentioned, in this connection, that with the exception of a few publications, mainly those concerned with aeronautics, marine engineering and internal-combustion engineering, there is at present no prohibition on the part of the German Government of the export of engineering publications. It has been stated, however, that the classes above referred to, as well as some of the medical and surgical periodicals, are not allowed to leave the country.

In the section Firing and Fuels is reproduced a chart prepared by Walter N. Polakov, Mem.Am.Soc.M.E., with which to make various records for coal.

Another article abstracted from *Power* deals with the control of smoking chimneys and describes a system of electric signaling by which an outside observer can call the attention of the firing squads to the fact that their stack is smoking. The subject of the flow in channels with large expansion ratio is abstracted in the section Hydraulics. The classification of this article is, however, somewhat uncertain, as it deals both with the flow of air and the flow of water.

In the section Machine Shop will be found brief answers given by various machine-tool builders showing their attitude toward motor drive. It is significant that the majority clearly recognize the value of motor drive, and that not a single company expresses its disapproval of this system.

A discussion of inspection of screw gages for munitions of war has been abstracted from a pamphlet published by H. J. Bingham-Powell, of the British Ministry of Munitions in the United States. We understand that this pamphlet is to be reprinted in part or in full in an early issue of the *American Machinist*.

In the same section attention is called to a brief list of specifications for munitions prepared by the Library of the Engineering Societies. While not claiming to be comprehensive, this list, it is believed, will prove of interest.

The refrigerator cars of the Baltimore & Ohio Railroad, described and illustrated in the section Railroad Engineering, are of interest in that the system of insulation is materially different from the usual practice. The bulkheads of the ice chambers are also made in a novel way.

In the same section, Railroad Engineering, an editorial has been abstracted from the *Railway Review* concerning standardization vs. improvement. The entrance of the United States into the war suddenly necessitating the production of vast quantities of direct and indirect war material largely in shops not designed to handle the particular class of material required, led the various boards to the adoption of a rather intensive system of standardization. This, in its turn, prompted an effort to extend standardization to fields where it was but sparingly known before. As shown by the editorial abstracted and by the account of the meeting of the Aeronautical Society of America, also in this issue, this tendency is beginning to meet opposition from various quarters. It may be of interest in this connection to recall that Sir David Henderson, formerly in charge of aircraft production in Great Britain, has also publicly cautioned this country against excessive standardization.

In the section Steam Engineering are two articles—one on nozzle characteristics and the other on purifying circulating water for surface condensers—which were indirectly abstracted from German publications.

Cleaning condenser tubes in place with hydrochloric acid, as practiced in South Africa, is described and illustrated. It appears that this method gives good results, but is rather expensive unless the acid can be secured at very low cost.

In the same section J. C. Hobbs, Mem.Am.Soc.M.E., describes a gas-fired boiler installation (from a paper before the Engineers' Society of Western Pennsylvania). This installation is of interest in many respects as several constructional difficulties had to be overcome. Among other things, it describes a horizontal-type baffle in the boilers, and a special gas burner permitting an absolute control of the relative quantities of gas and air.

Heat transfer from air to pipes forms the subject of an extensive discussion by Charles H. Herter before the American Society of Refrigerating Engineers. One of the conclusions arrived at by the writer is that, within certain limits of velocity of flow, the coefficient of heat transfer from air to pipe varies approximately as the two-thirds power of the velocity instead of as the square root of the velocity as has frequently been stated.

Friction of slime pulp in pipes is discussed by E. J. Laschinger in a paper before the South African Institution of Engineers and is abstracted in the section Varia.

# REVIEW OF ENGINEERING PERIODICALS

SUBJECTS OF THIS MONTH'S ABSTRACTS


International Aircraft Standards
Airscrew Analysis
Optimum Diameter of Airscrew
Measurement of Air Delivered by a Turbo Blower
Drop of Pressure in Compressed Air Hose
Hardening of Aluminum Bronze
Chart for Coal Records
Control of Smoking Chimneys
Water Wheel as Dynamometer
Flow in Channels with Large Expanding Ratio
Machine Tool Builders and Motor Drive
Inspection of Screw Gages for Munitions
Measurement of Pitch in Screws
Measurement of Full and Effective Diameter of Threads
Equipment for Checking Screw Gages
Specifications for Munitions
Refrigerator Cars for the Baltimore & Ohio Railroad
Standardization vs. Improvement in Locomotive Practice
Steam Nozzle Characteristics
Purification of Circulating Water for Surface Condensers
Cleaning Condenser Tubes with Hydrochloric Acid
Gas Fired Boiler Installation
Sand and Asbestos Joint in Rectangular Stack
Nozzle Connection in Breeching Permitting Expansion
Horizontal Type Baffle in Boilers
Gas Burner for Use Under Boilers
Steam Boilers and Economizers
Heat Transfer from Air to Pipes
Friction of Slime Pulp in Pipes
Draft and Enrollment in Engineering Schools
Charts


*For Articles on Subjects Relating to the War, see Aeronautics, Firing and Fuel, Munitions, Railroad Engineering, Varia.*

## Aeronautics

International Aircraft Standards. The following standards were recently adopted by the International Aircraft Standards Board:

*Specification for Soft Solder.* The specification determines the composition of the solder and, among other things, demands that it be made from new tin and commercially pure new lead.

*Babbitt Metal for Bronze-Backed Bearings.* The specification determines the composition of the material and the methods for taking a sample for analysis and of manufacture. No scrap is permitted to be used other than that produced in the manufacturers' own plants, and which is of the same composition as the material specified.

*Seamless Brass Tubes.* The specification determines the composition of the material, method of manufacture, physical properties and tests. It is stated that this tubing is resistant to the corrosive action of salt water, salt air and gases. As regards tests, the following are specified: flattening test, expanding test, and hydrostatic pressure test, in the latter case with a tensile stress of 7000 lb. per sq. in. in the tube, but in no case shall a test pressure of more than 1000 lb. per sq. in. be required. A table of tolerances of outside diameters and wall thicknesses is also given. Among other things, it is stated that when no length is specified, the tubes may be shipped in stack length of 10 ft. to 14 ft. When ordered in definite lengths, no length shall be less than that specified.

*Phosphor-Bronze Castings for Bearings.*

*Cold-Rolled or Drawn Carbon-Steel Bars.* A table is given showing the physical properties indicated by a tensile test; namely, minimum tensile strength, minimum yield point, minimum elongation in 2 in. or proportion gage length, and minimum reduction of area for bars under 0.75 in. diameter of width across the flats from 0.75 to 1.50 in. and over 1.50 in. The composition is indicated with maximum phosphorus 0.045 and maximum sulphur 0.050, except for electric- or crucible-furnace steel, where the maximum allowable percentage of phosphorus and sulphur may, at the option of the purchaser, be limited to 0.034 per cent.

Användandet af Logaritmiska Polarkurvor, vid Beräkning af Flygmaskiner, Henry Kjellson, *Teknisk Tidskrift*, Mekanik, 47 Arg., Häft 10, October 10, 1917, pp. 85-87, 3 figs. Application of logarithmic polar curves to calculations of heavier-than-air flying machines.

The Sopwith Triplane. *Automotive Industries*, vol. 37, no. 24, December 13, 1917, p. 1044.

The 160 hp. Benz and Mercedes Aircraft Engines Compared. *Aviation*, vol. 3, no. 9, December 1, 1917, pp. 610-615, 31 figs., 8 tables. Comparative data are given as to the general detailed dimensions, friction losses in engines, gas velocities, inertia forces, valve details, power curves, crankshaft dimensions, etc. Various parts of the two engines are illustrated side by side so as to show the respective constructions.

Airscrew Analysis, A. F. Zahm. *Aviation*, vol. 3, no. 9, December 1, 1917, pp. 601-608, 15 figs. Aerodynamic analysis of the operation of an airscrew, followed by a stress analysis. Among other things, the writer shows a propeller computer which is a kind of slide rule by which the thrust efficieney and various intensive properties of a propeller blade can be quickly derived.

Some Notes of the Airscrew and the Problem of Optimum Diameter, E. P. King. *Aeronautics*, vol. 13, no. 210 (new series), October 24, 1917, pp. 308-314, 6 figs. Discussion of a method of determining the best diameter for a propeller, such method to be employed in a particular case where restrictions as to engine power, speed and revolutions are completely defined. The writer attempts to reconcile the Newtonian method with the blade method and expresses the belief that there is no real discrepancy between the two methods, except in quantities utilized.

French and British Stationary Aero Engines. *Flight*, no. 462 (no. 44, vol. 9), Nov. 1, 1917, pp. 1137-1139, 16 figs.

Biplan allemand bi-moteur triplace Friedrichshafen, 450 HP., type G H. *L'Aérophile*, 25 Annee, nos. 19-20, October 1-15, 1917. Description of a twin-engined three-passenger German biplane carrying 450 hp. in engines.

Metal in Aeroplane Construction, A. Pomilio. *Aerial Age Weekly*, vol. 6, no. 9, November 12, 1917, p. 378.

Economy of Tight Air Hose Connections, Glenn B. Harris. *American Machinist*, vol. 47, no. 23, December 6, 1917, pp. 985-986. Points out the frequent occurrence of costly leaks in air lines and hose, and recommends a number of remedies to prevent the costly waste of power.

## Air Engineering

MEASURING AIR DELIVERED BY A TURBO-BLOWER, Thomas G. Estep, Jr. In the measurement of air delivered by a turbo-blower to blast furnaces a new problem has been presented to engineers. It is very essential that the volume of air delivered to the furnace be known at all times, and it is even desirable that a continuous record of this quantity be obtained so that a comparative study of the furnace operation can be made.

The blower itself does not give any means of determining this quantity. On the other hand, as it produces a steady flow, any of the approved methods of measuring gases can be used, the only question being to select the most accurate and simple method. A pitot tube in the intake pipe suggests itself as a simple means of measurement, but before such an installation will give reasonably accurate results certain factors must be taken into consideration, such as the uniformity of the internal diameter of the intake pipe, the possibility of eddy currents in the pipe due to the presence of ring seams, and finally the possibility of the intake pipe being so short that the flow does not become uniform before being measured.

The writer recommends as the best solution a combination of a standard orifice and a pitot tube. The standard orifice may be placed in the end of the intake pipe directly under the hood, and the pitot tube used to measure the velocity of the air leaving the orifice.

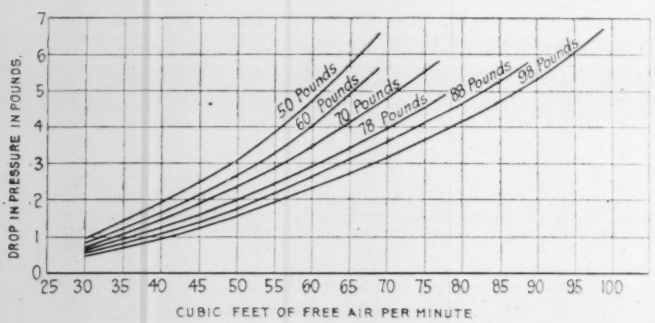



FIG. 1 DROP IN PRESSURE IN WOVEN HOSE AGAINST AIR DELIVERED AT DIFFERENT PRESSURES

With this arrangement practically no changes are required in the intake pipe. The hood may have to be raised a little in order to install a screen and give a free inlet to the orifice. Some tests made at the laboratories of the Carnegie Institute of Technology showed that if the hood was at least one-quarter the diameter of the pipe away from the orifice it would have no influence on the flow.

With the orifice at the end of the pipe the velocity of approach is zero, which facilitates the construction of the chart of the recording mechanism. Further, with this location of the orifice, static-pressure determinations are not necessary, and the pitot tube in reality becomes a simple impact tube, with just one connection to the recording device.

The length of the intake pipe has no influence on the measurements. If the orifice diameter bears the proper relation to the pipe diameter, the loss in pressure in negligible. Carnot many years ago proposed an equation for this loss, as follows:

$$\text{Lost head} = \frac{(V_2 - V_1)^2}{2g}$$

where $V_1$ = velocity of fluid in pipe, ft. per sec.
$V_2$ = velocity of fluid in orifice, ft. per sec.
$g$ = acceleration due to gravity, ft. per sec.

and the lost head is in feet of the fluid being measured. Tests made at the Carnegie Institute of Technology showed that this equation will give fairly close results. When the velocities are low the calculated loss is too high, and when the velocities are high the equation gives results too low. Over the range of velocities used in the tests, the variation of the actual and calculated loss did not exceed 7 per cent. If an orifice diameter of about six-tenths of the pipe diameter is used, and the lost head reduced to actual additional horsepower required to drive the turbo-blower, it is found that it amounts to less than one half of one per cent. (*The Blast Furnace and Steel Plant*, vol. 5, no. 12, December 1917, pp. 558-559, 1 fig., *pe*)

DROP OF PRESSURE IN COMPRESSED-AIR HOSE, Walter S. Weeks. Data of tests made last year under the writer's direction in the Mining College of the University of California to determine the drop in pressure that compressed air undergoes in passing through a 50-ft. length of commercial air-drill hose.

The tests were made on $\frac{3}{4}$- and 1-in. hose, and the results are presented in the form of charts, of which the one for the $\frac{3}{4}$-in. hose is reproduced in Fig. 1. Approximate tests were also made on the drop through the fittings alone, but this proved to be quite negligible.

The writer also makes some practical suggestions. It is necessary to have the hole in the hose of the specified size. The hose with the most "give" has the least drop in pressure, because when it is under pressure the diameter of the hose is slightly increased. Wire-wound hose is very rigid, and in addition often corrugated by the tight winding. These corrugations increase friction and constrict the opening. (*Western Engineering*, vol. 8, no. 11, November 1917, pp. 434-435, 3 figs., *e*)

Attention is called in this connection to the article, Economy of Tight Air-Hose Connections, Glenn B. Harris, *American Machinist*, vol. 47, no. 23, December 6, 1917, pp. 985-986.

## Cooling

MECHANICAL WATER COOLING ON THE "HEENAN" PRINCIPLE. *Indian and Eastern Engineer*, New Series, vol. 41, no. 13, September 1917, pp. 85-86, 2 figs. Description of the "Heenan" cooler applied particularly for cooling jacket water of stationary gas engines. The cooler consists of cylinders built up of galvanized sheeting wound into the form of a spiral with the air space to each convolution. It will be described more fully in an early issue of THE JOURNAL.

## Engineering Materials

HARDENING OF ALUMINUM BRONZE. According to an article in the *Giesserei Zeitung* for June 1, aluminum bronzes can be improved by thermal treatment. When they contain less than 7 per cent copper, the thermal treatment will not affect the properties much. Higher-grade bronzes can be hardened, however, and by the further addition of iron, silicon and other elements the mechanical properties of the alloys can be much varied. Thus, e.g., bronzes can be prepared having a Brinell hardness of 100 without being brittle. An aluminum bronze resembling in its mechanical properties a 0.35 carbon Swedish steel was given hardness values ranging from 100 to 260 by various thermal treatments; such bronzes of great hardness will answer as bearing metals even for high speeds. The following figures are given as to the properties of a 10 per cent aluminum bronze containing some titanium, the percentage of which is not quoted:

| | Bronze as Cast. | Quenched Bronze. | After Thermal Treatment at Different Temperatures |
|---|---|---|---|
| Limit of elasticity.... | 9.6 | 19.8 | 27.7 to 19.2 kg. per sq. cm. |
| Tensile strength..... | 51.8 | 73.6 | 67.7 to 64 kg. per sq. cm. |
| Elongation ..... | 19.5 | 1.6 | 5.5 to 1.4 per cent |
| Contraction of area... | 33.7 | 0.8 | 9 to 18.5 per cent |
| Brinell hardness..... | 100 | 262 | 158 to 146 |

(*The Journal of Industrial and Engineering Chemistry*, vol. 9, no. 12, December 1917, pp. 1144, *p*)

TESTS OF CORK FOR FRICTION CLUTCHES AND OTHER SIMILAR PURPOSES, G. G. Becknell and C. N. Wenrich. *American Machinist*, vol. 47, no. 23, December 6, 1917, p. 972.* Data on cork tests obtained in the laboratory of the University of Pittsburgh, including a summary of coefficients of friction. Also data with charred cork to determine the value of cork in dry-clutch work where intense heat is likely to be developed.

HYDRATED LIME AND ITS QUALIFICATIONS AS A STRUCTURAL MATERIAL, Bela Nagy. *Proceedings of The Engineers' Society of Western Pennsylvania*, vol. 33, no. 7, October 1917, pp. 457-473, 7 figs.

RECHERCHES SUR LA DILATION THERMIQUE ET SUR LA VITESSE DE DISSOLUTION DES ACIERS AU CARBONE, Joh. Driesen. *Revue de Métallurgie*, 14e Année, no. 5, September-October 1917, pp. 683-706, 14 figs., 8 tables. Investigation of thermal expansion and velocity of solution of carbon steels.

RUSTPROOFING IRON AND STEEL, Joseph W. Wilmsch. *Machinery*, vol. 24, no. 4, December 1917, pp. 309-311, 3 figs.

THE MICROSTRUCTURE OF COMMERCIALLY PURE IRON, W. J. Brooke and F. F. Hunting. *Engineering*, vol. 104, no. 2707, November 16, 1917, pp. 532-534, 14 figs.

SUR LES PROPRIÉTÉS RÉFRACTAIRES DE LA MAGNÉSIE, H. Le-Chatelier and B. Bogitch. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, tome 165, no. 16, October 15, 1917, pp. 488-491, 1 fig., 2 tables. Discusses the refractory properties of magnesia.

PROPERTIES OF VARIOUS WOODS, compiled by A. Pomilio. *Aerial Age Weekly*, vol. 6, no. 9, November 12, 1917, p. 379.

## Evaporators

TEST OF SCHUTTE AND KOERTING EVAPORATOR, M. C. Stuart. *Journal of the American Society of Naval Engineers*, vol. 29, no. 4, November 1917, pp. 725-738, 4 figs., 1 plate. An abstract of this paper will appear in an early issue of THE JOURNAL.

## Firing and Fuel

CHART WITH WHICH TO MAKE VARIOUS RECORDS FOR COAL, Walter N. Polakov, Mem.Am.Soc.M.E. With the present scarcity of coal, the old slipshod manner of handling coal records should not be tolerated. By using the chart Fig. 2, the following information can be gained at a glance: (1) Quantity of coal on hand (bin or yard); (2) daily coal deliveries; (3) when unloading started and finished; (4) daily balance on hand; (5) heat value, ash and volatile contents of each delivery; (6) daily coal consumption; (7) coal consumption per kilowatt-hour; (8) cumulative consumption of coal to date; (9) on what day any certain coal was used; (10) the demurrage, if any.

The construction of the chart requires two main scales, namely, time (days of the month) and quantity (pounds of coal). The coal-consumed curve is started from zero on the first of the month, as shown, and grows gradually as coal is used from the overhead bin or yard each day. The vertical distance by which the curve rises from day to day gives the daily consumption, and the ordinate at the end of the line indicates the total coal used.

The amount of coal delivered is shown to the left of the coal-consumed curve, the grade being lettered opposite the line representing the quantity. The vertical bars representing the deliveries are divided to represent what portion of the total is in the overhead bin, what is in the yard pile, and how much is ready for unloading from the barges or cars. As the contents of each barge or car are consumed, the length of the bar representing the amount of its contents is projected on the coal-consumed curve, indicating in this manner the duration of the period during which its load was utilized.

Whenever a new delivery is made, a new bar indicating the amount is started on the day when the barge or car arrived at

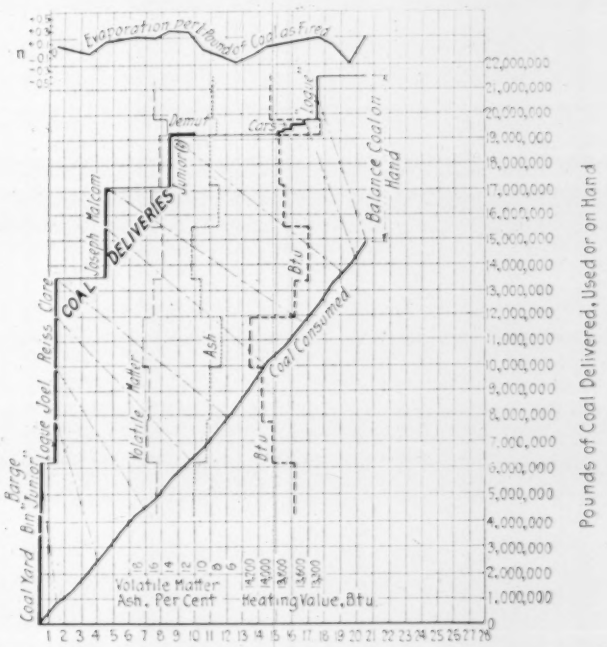



FIG. 2 METHOD OF RECORDING DATA REGARDING COAL SUPPLY, CONSUMPTION, ETC.

the dock or siding, while the horizontal line after each new delivery thus represents the time elapsed as periods between deliveries. The heavy part of the horizontal line represents the length of time during which the demurrage charges were accumulating.

The analysis of coal for each delivery may be shown as complete as desired, being indicated horizontally opposite each delivery. In the case illustrated, only the heating value, ash and volatile percentage are shown. In the upper part of the chart is a reference curve showing the evaporation per pound of coal. Any other relation, such as boiler efficiency or pounds of coal per kilowatt-hour, which may be of use can also be placed here.

To facilitate using these charts they can be plotted daily on cross-section tracing cloth, and blueprints can be sent from time to time (generally weekly) to the managers and purchasing agents. (*Electrical World*, vol. 70, no. 19, November 10, 1917, pp. 911-912, *p*)

CONTROLLING SMOKING CHIMNEYS. Description of a method of electric signaling to indicate to the firemen the fact that the stack taking care of their set of boilers is smoking. The system described has been installed at the Duquesne Light Company's Brunots Island Power Station on an island in the Ohio River.

The station is served by 50 boilers having a total of 32,460 boiler hp., nominal rating. These boilers are served by 18 chimneys.

The system was designed mainly as an aid in preventing smoke. In each boiler room above the firing aisle is a red incandescent lamp enclosed in an opal globe so as to increase the glow of the lamp. Outside there is an observation house so situated that the observer has a view of all chimneys. In front of the observer is a switchboard through which he can control any of the red lamps.

The operation of the system is essentially as follows:

The operator observes that, say, No. 3 stack is making smoke corresponding to No. 2 chart. The switch of No. 3 circuit is thrown, which lights the lamp in front of the fireman who is operating the boilers served by No. 3 stack, and also brings the No. 3 recording pen of the time recorder into action. Both the combustion engineer and the water tender are available to asssist him, if needed. When the smoke has been reduced to correspond to No. 1 chart, the switch is opened, thus cutting out the lights and the pen of the time recorder.

The adoption of this system eliminated erroneous entries which might easily occur if the log system only were used. The charts are changed daily and filed for future reference. (*Power*, vol. 46, no. 22, November 27, 1917, pp. 718-720, 4 figs., *g*)

METHODS FOR MORE EFFICIENTLY UTILIZING OUR FUEL RESOURCES. *General Electric Review*, vol. 20, no. 12, December 1917, pp. 924-939, 12 figs. Parts 7 and 8.

DOUBLE PASS RECUPERATIVE FURNACES. *Iron Trade Review*, vol. 61, no. 24, December 13, 1917, pp. 1277-1278, 2 figs. Special brick used in the construction of this type of furnace heats the incoming gas continuously and eliminates the reversing valves required in other heating systems.

## Heating

CALCULATIONS AND ANALYSIS OF A COMPOUND GRAVITY LOW-PRESSURE HOT WATER SYSTEM, A. J. Wells. *Journal of the American Society of Heating and Ventilating Engineers*, vol. 24, no. 1, October 1917, pp. 1-22, 11 figs., 2 tables, 5 charts.

## Hoisting

HISTORY OF WIRE HOISTING ROPES, WITH NOTES ON FACTORS OF SAFETY. *Engineering and Mining Journal*, vol. 104, no. 19, November 10, 1917, pp. 832-835.

## Hydraulics

REVERSAL OF WATER WHEEL TO ABSORB ENERGY DURING TEST. In the cross-cut hydroelectric plant built for the U. S. Reclamation Service on the Salt River Reclamation Project in Arizona, it was agreed that the high voltage and low amperage made it inadvisable to employ the usual water-rheostat method for absorbing the load in carrying out efficiency tests. It was therefore decided to connect the generator of the wheel under test with the generator of another unit in such way that the latter would be run as a motor. In this way the load would be taken up by the jets from the nozzles retarding the reverse rotation of the buckets.

This was done with hand regulation. One penstock was used for supplying water to the unit under test, and another for supplying water to the exciters and providing the load in the braking unit. With water admitted through the nozzles of the unit operated as a synchronous motor, electric energy was absorbed in direct relation to the hydraulic energy developed by water passing through its nozzles.

The stresses imposed on the buckets were directly opposite to those for which the unit was designed. Nevertheless, the motor unit was operated in this condition almost continuously for two days. While the Kingsbury bearing on the motor unit was designed for rotation in one direction only, it showed no undue distress throughout the entire run. (*Engineering News-Record*, vol. 79, no. 22, November 29, 1917, p. 1023, *t*)

FLOW IN CHANNELS WITH LARGE EXPANSION RATIO, R. Kröner. (*Zeits. Vereines Deutsch. Ing.* 61, pp. 665-669, July 21, and pp. 630-633, July 28, 1917). This research comprises a detailed investigation of flow in close channels, following the work commenced by Andres and Hochschild. The complexity of the phenomena necessitates three-dimensional investigation of the flow. Special importance is attached to measurement and representation of losses; and the distribution of velocity and pressure is investigated. Air is used as the fluid medium in order to reduce the use of the large pipes required for close examination of stream lines, etc. The velocities of the flow are so low that the compressibility of air does not enter into the case. The Prandtl tube is used to measure the "velocity height" $\gamma w^2/2g$; where $\gamma$ = specific gravity of air and $w$ = velocity of flow. Double and treble search tubes are used in conjunction with manometers to determine the plane and direction of flow; the readings of the Prandtl tube and of a right-angled "hook tube" (indicating the "energy" $e = p + \gamma w^2/2g$, where $p$ = static pressure) are corrected according to the obliquity of stream flow. The experimental pipe used was 4 m. long and 250 mm. square. It was connected in the suction line of an electrically driven fan with suitable provision made to eliminate extraneous influence on the stream flow. The construction and arrangement of the measuring devices are illustrated in the original. A novel feature is a semi-automatic pen recorder which gives more accurate results than point-by-point readings, and also saves time and labor. A pivoted beam with two pressure bells of gasometer type insures, in conjunction with a relay system, that the driving motor runs at constant speed.

Insertion pieces of five different designs were used to reduce the canal section to a rectangular slot from 67.2 to 68.3 mm. wide in the several cases and with the full height of the channel. The constricting "nozzle" was of the same form in each case, and was 260 mm. long axially. In case A the constricting nozzle was used alone so that the channel increased abruptly in the ratio 1:3.62. In the other four cases fat sheets were used to provide rectangular expansion cones, the half expansion angles and the expansion ratios being: (I) 45 deg.; 1:3.7. (II) 22 deg. 34 min.; 1:3.64. (III) 12 deg.; 1:3.67. (IV) 5 deg. 53 min.; 1:3.69. The "nozzles" were symmetrical about a vertical plane through the axis of the channel, and were composed of zinc plates over wooden frames. Coördinates adopted were $x$ positive in the direction of flow and reckoned from the narrowest section as zero; $y$ and $z$ from the right-hand upper corner of the main canal as viewed in the direction of flow, $y$ positive to the left and $z$ positive downward. Losses were reckoned from the narrowest section. Over 1000 curves were prepared during the main series of the tests. Considerable difficulty was experienced in some cases in restoring the exact conditions of flow which it

was desired to check or investigate; often a sudden change from one type of flow to another occurred without any particular reason being evident. Evaluation of test data and correction for certain errors are discussed in a portion of the original which cannot usefully be abstracted. Velocity, pressure, and loss of power are reduced to dimensionless quantities to permit of comparison between one channel and another, and lines of equal velocity are traced for those sections which show the velocity as a function of $z$ to be very variable. The measurements show flow to be very asymmetric in cases A and I to III inclusive, also that different forms of flow are in the same channel. In case IV the flow jumps continually from one state to another. Pressure loss in case A showed a small departure from the square law; and the departure was comparatively large in case IV. Curves in the original show the more or less unstable alternative conditions of flow in some places. In no case has the power loss curve the cubic form which would correspond to a quadratic law of resistance; the curves are not harmonic among themselves, the losses being dependent on the extent of the back-flow zone.

The paper concludes with a comparison of the mechanical similarity between flow in air and water, based on channel IV. More definite conclusions and a discussion of the application of the results may be given in the detailed report of the research, which is to form a separate publication. (*Science Abstracts*, vol. 20, no. 238, section B, October 31, 1917, p. 362)

LES COUPS DE BÉLIER DANS LES CONDUITES FORCÉES, C. Camichel and D. Eydoux. *Revue Générale des Sciences pures et appliquées*, 28e Année, nos. 20, 21, October 31 and November 13, 1917, pp. 565-574, 610-615, 18 figs. Description of the theory and determination of magnitudes of water hammer in conduits under pressure.

PULSATIONS IN PIPE LINES, AS SHOWN BY SOME RECENT TESTS, H. C. Vensano. *Proceedings of the American Society of Civil Engineers*, vol. 43, no. 8, October 1917, pp. 1593-1643, 31 figs. Data of a highly interesting series of experiments and measurements of water hammer in long pipe lines made under actual operating conditions. They show what can be expected, particularly, in the way of wave effects, and demonstrate that pulsations, whether due to gate opening or closing, can by no means be neglected in design, even for lines which are controlled by slowly moving gates.

## Internal-Combustion Engineering

A PETROL ENGINE RING VALVE, A COMPARISON WITH OTHER TYPES, A. E. Hammond. *Flight*, no. 463 (no. 45, vol. 9), November 8, 1917, pp. 1170-1172, 10 figs. Description of the Howard slide valve as applied to an aircraft engine. The valve consists of broad, flat split rings covering annular slots cut through the walls of the working cylinder on opposite sides, and made to move with the cylinder in parts at each end of its travel, its mid-position shutting both parts gastight. The ring being split allows full force of compression and explosion to hold it gastight against the cylinder wall.

DIESEL ENGINE REVOLUTION-SPEED AND EFFICIENCY, T. Orchard Lisle. *Motorship*, vol. 2, no. 12, p. 9.

## Lubrication

LUBRICANT TESTING, Lieut. Commander J. G. Meyers. *Journal of the American Society of Naval Engineers*, vol. 29, no. 4, November 1917, pp. 698-712, 4 figs.

## Machine Design

EXPANSION BENDS. *Mechanical World*, vol. 62, no. 1609, November 2, 1917, pp. 245-246, 5 figs.

## Machine Shop

ATTITUDE OF MACHINE-TOOL BUILDERS TO MOTOR DRIVE, C. E. Clewell. In order to gage the recent tendencies in machine-tool design which have been brought about at least partly by the growing use of motor drive, a number of typical questions were addressed to representative machine-tool builders. The article here abstracted represents a digest of the answers obtained. Besides the general expression of opinion, the various manufacturers indicated also the approximate percentage of output supplied for individual motor drive, group electric drive and straight-line shaft drive, and recent changes in machine tools adapting them specifically to motor drive.

From these data it appears that a very large percentage of machines of the majority of machine-tool manufacturers are supplied for electric drive.

The following represents in a general manner the expression of the attitude of the different companies toward motor drive:

1 *Lodge & Shipley.* In general, group drive is preferred to individual drive, except in cases where a few machines are run on overtime or at night, and for the reversing control of planers and where crane operation is facilitated by the elimination of overhead shafting.

2 *Ingersoll Milling Machine Company.* Individual motor drive is preferred.

3 *Jones & Lamson.* The tendency is strongly toward motor-driven machinery, motors being used practically always on heavy machinery, and, where conditions permit, also on lighter lathes, drill presses and the like.

4 *Cincinnati Bickford Tool Company.* Not much choice is expressed between a speed box and a variable-speed motor for standard tools. For special schemes of mounting, the motor drive is preferable.

5 *International Machine Tool Company.* Individual motor drive is preferred to any other method of drive.

6 *Bridgeford Machine Tool Works.* Individual motor drive is preferred for machine tools requiring 20 hp. or more, group drive for machines which require not more than 5 hp. or 6 hp. All machines that are made by this company and have gear heads are heavy-duty, requiring 10 hp. to 15 hp. In 95 per cent of the cases involving these machines motor drive is specified. Very few geared-head machines are belt-driven

7 *Cincinnati Planer Company.* Wherever possible, electrically driven tools are favored.

8 *Bausch Machine Tool Company.* Favorable to motor-driven machinery.

9 *Foster Machine Company.* About 80 per cent of the machine tools in this company's plants are individually motor-driven.

10 *American Tool Works Company.* The preference of this company for motor-driven or belt-driven machine tools is influenced entirely by the conditions under which these tools are to be operated. Both types of machines are handled and each has a legitimate field of operation. (*Electrical World*, vol. 70, no. 29, November 24, 1917, pp. 994-997, 10 figs., *g*)

CASTING BEARINGS IN SAND AND METAL MOULDS, R. R. Clarke. *The Metal Industry*, vol. 15, no. 12, December 1917, pp. 516-517.

REPAIRING GERMAN VANDALISM BY ELECTRIC WELDING,

Commander E. P. Jessop. *Journal of the American Society of Naval Engineers*, vol. 29, no. 4, November 1917, pp. 663-672, 7 figs., 3 tables. Description of some electrical-welding repair jobs done on the interned German ships taken over since the war by the United States authorities.

POWER REQUIRED FOR DRIVING REAMERS. *Machinery*, vol. 24, no. 4, December 1917, p. 337. Data of tests made at the Worcester Polytechnic Institute to ascertain the effect of reamer design on the power required for driving reamers of different types. It was found that the main element affecting power is the keenness of the cutting edges.

UNIFICATION DES FILETAGES. *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, tome 128, no. 4, Juillet-Aout 1917, p. 84. Brief note on screw-thread standardization in France.

EXTRACTS FROM A PAPER ON SCREW THREAD MEASUREMENTS, read by the late Mr. Arthur Brooker. *The Post Office Electrical Engineers' Journal*, vol. 10, part 3, October 1917, pp. 153-170, 3 figs.

EMPLOI DES OUTILS EN ACIER MOULÉ RAPIDE, M. Grenet. *Revue de Métallurgie*, 14e Annee, no. 4, July-August 1917, pp. 547-550. Brief description of the use of high-speed-steel cast tools. An abstract will appear in an early issue.

TAPPING MACHINES AND ATTACHMENTS, Franklin D. Jones. *Machinery*, vol. 24, no. 4, December 1917, pp. 319-328, 27 figs.

A STUDY OF VELOCITY DIAGRAMS FOR SHAPERS AND SLOTTERS, A. Lewis Jenkins. *American Machinist*, vol. 47, no. 17, October 25, 1917, pp. 709-711, 10 figs.

## Mechanics

THE WHIRLING OF SHAFTS, H. A. Webb. *Engineering*, vol. 104, no. 2705, November 2, 1917, pp. 455-456. (To be continued.)

WORM GEARING, Francis J. Bostock. *Engineering*, vol. 104, no. 2705, November 2, 1917, pp. 479-480, 6 figs. Paper read before the Manchester Association of Engineers on October 27, 1917. An abstract will appear in an early issue.

ANALYSIS OF CRANKSHAFT STRESSES, Otto M. Burkhardt. *Automotive Industries*, vol. 37, no. 21, November 22, 1917, pp. 925-927, 6 figs.

COMBINED TWISTING AND BENDING MOMENTS, Victor M. Summa. *Machinery*, vol. 24, no. 4, December 1917, pp. 307-308. The writer shows by examples how the so-called Rankine formulæ may be applied to the determination of the combined twisting and bending movements.

THE WHIRLING OF SHAFTS, H. A. Webb. *Engineering*, vol. 104, no. 2707, November 16, 1917, pp. 513-515, figs. 8-11. (Concluded.)

## Measuring and Testing

AN IMPACT-ENDURANCE TESTING MACHINE, D. J. McAdam, Jr. *Journal of the American Society of Naval Engineers*, vol. 29, no. 24, November 1917, pp. 663-672, 7 figs., 3 tables.

DILATOMÈTRE DIFFÉRENTIEL ENREGISTREUR, DESCRIPTION ET PREMIÈRES APPLICATIONS, M. Pierre Chevenard. *Revue de Métallurgie*, 14e Annee, no. 5, September-October 1917, pp. 611-640, 23 figs. Description and method of application of a new type of self-registering differential dilatometer.

## Munitions

THE INSPECTION OF SCREW GAGES FOR MUNITIONS OF WAR, H. J. Bingham-Powell. Attention in the inspection of gages has until recently been principally given only to correctness of the ruling diameters of the thread. The matter of pitch was largely disregarded, mainly because of the lack of an instrument which could measure it from thread to thread in a rapid and exact manner independent of the personal equation of the operator.

Within the last two years, however, the question of pitch became prominent because of the accuracy required in the screw gages used on munition work.

A number of devices exist to measure the pitch based on the idea of measuring over a given number of threads. There are also a few machines to measure the pitch from thread to thread, but they have the defect that the accuracy of the operation depends on the care taken by the user. In England the pitch-measuring machine invented by Vidal is claimed to have overcome these troubles. Instead of the V-point is used a ball so arranged that it can bear evenly in the thread without the inclination of the spindle to which it is fixed. This ball is split with a lamina of mica interposed as insulation between the two portions. Electric circuits are made between the halves of the ball and the screw, and will only close when the ball is touching the slope of the thread on both sides. The spindle with the ball is connected to a longitudinal carrier of a triangular-truss form, with the spring arranged to press it toward the screw and so keep the ball in continually light contact with the thread. The adjustment given by the spring is so delicate that the carrier can be blown away from the contact by the breath. Since the ball and the screw must be quite clean and free from grease in order that the electric circuit may be established, the operator knows at all times that he has obtained a true contact on the thread without an intervening film of oil.

The writer was impressed by the fact that in all the existing designs the devices for insuring that the V-points or ball-pointed spindles resting in the screw bore equally on both sides of the thread depended on visual inspection, electric contact or reflection from a mirror on to a scale. The writer believes that a more convenient way to design the bearing on the thread is to arrange that this is fundamentally so without having to rely on electrical, optical or other devices to prove it. If a suitably sized ball is dropped into a screw, this ball must naturally assume an equal bearing on both slopes. If it were possible to have such a ball placed between guides so that its center was always over the axis of the screw and then to arrange a microscope moved by a micrometer head or similar measuring system and read down on it a point on the ball or else to an engraved line on the flat surface on a hemisphere instead of the complete ball, the solution would be complete.

However, there is no satisfactory way of knowing that the ball is in proper position. But if for the simple ball or half ball is substituted a ball-ended spindle that freely bears vertically or nearly vertically into the screw and is suitably guided along the axis from thread to thread, its movement being measured by a micrometer head, a satisfactory basis for designing the machine is found, and this is the principle adopted by the writer.

The paper describes and illustrates the machine in detail.

From this the writer proceeds to a discussion of measurement of the full effective core diameters of the Whitworth thread and of the full and effective diameters of the United States standard threads of plug screw gages and ring screw gages.

The writer recommends the following equipment for checking screw gages:

1 A pitch-measuring machine to read from thread to thread, to at least 1/10,000 of an inch
2 An appliance to take casts of ring screw gages, so arranged that the cast may be accurately set up in the pitch machine, or projection apparatus
3 A screw-measuring machine to check the governing diameters of a plug screw gage with accuracy to 1/10,000 of an inch. An equipment of "best" diameter and "maximum" diameter wires, and triangular pieces for the same
4 Thread micrometers, checked for accuracy, to use in conjunction with the screw-measuring machine
5 Ordinary micrometers, to measure full diameters, with Johansson blocks to keep them accurate
6 Complete sets of check plugs for the several diameters, pitch and form of thread of ring screw gages.

Finally, the equipment would be complete with a "projection" apparatus for observing the angle between the slopes of the thread and the form of the thread.

Possessing an inspection laboratory with these instruments, a gage maker is in a position to produce the very accurate screw gages employed in munitions work, and to meet all the requirements of the inspection departments of the several governments. (Pamphlet, N. Y., 1917)

SOME SPECIFICATIONS FOR MUNITIONS. The following list of specifications has been prepared by the Library of the Engineering Societies:

1896.—Specification for Steel for Gun-Barrels.—U. S. Government Specification, 1896. (Washington, D. C., Annual Report of the Chief of Ordnance, pp. 69-72.) Requirements are an elastic limit of 60,000 lb., tensile strength not under 100,000 lb., and an elongation of 15-20 per cent. The chemical limits were not to exceed: C, 0.50; Mn, 0.60; Si, 0.16; S, 0.034; P, 0.045. Analyses and tests are given of a large number of submitted samples, but none was quite up to the standard.

1897.—Armor-Piercing Projectiles (8-, 10- and 12-in. shot for the U. S. Government), 1897. (*The Engineer*, London, vol. 84, pp. 504-505.) Dimensioned sketches and specifications.

1907.—Qualities Necessary for Gun Steel, Carriage Steel, Spring Steel, Shield Steel (excluding armor-plate steel) and Shell Steel, 1907. (*Times Engrg. Suppl.*, May 22, p. 162). Specifications and tests of various steels in current use are given.

1913.—Bulleus, D. K., The Manufacture of Armor Plate, 1913. (*The Iron Age*, vol. 92, p. 953-954.) Details of the Harvey and Krupp processes. An American method described. Chemical composition and prices compared. Specifications for protective plates.

1915.—Specifications for High-Explosive Shells. Abstract of the Official British, French and Russian Government Specifications for high-explosive shells and fuses. New York, 1915. The Industrial Press, publishers of *Machinery*, 44 pp. (Pamphlet, p. 623.45 M. 185.) Gives details regarding Russian 3-in. H.-E. shell; Russian high-explosive percussion fuse; British H.-E. shells; British high-explosive shell fuse; French 75-mm. H.-E. shell.

1916.—French Specifications for Shell Steel. 1916. (*The Iron Age*, August 31, vol. 98, pp. 450-451.) Details regarding the specifications of the French government for shell steel. The bars are to be rolled or forged steel of the best quality, made either by the acid or basic open-hearth process, or electric-furnace processes, free from seams, floors, piping and porosity. The conditions of annealing are described, as well as those of temper drawing after quenching, and the mechanical requirements are also given. Twenty-eight per cent top discard and 4 per cent from the foot is stipulated, and the percentage chemical composition is specified as follows:

| | Minimum | Maximum |
|---|---|---|
| C | 0.30 | ... |
| Si | 0.15 | 0.25 |
| Mn | 0.50 | 0.80 |
| P | 0.03 | 0.08 |
| S | ... | 0.05 |

THE MANUFACTURE OF THE LEWIS MACHINE GUN, *American Machinist*, vol. 47, no. 23, December 6, 1917, pp. 969-971, 11 figs. (To be continued.)

SPECIAL AUTOMATIC RIFLE-BARREL MACHINE, E. H. Ingram. *American Machinist*, vol. 47, no. 21, November 22, 1917, pp. 905-908, 3 figs.

WEAR IN BIG GUNS, Major T. G. Tulloch. *Arms and Explosives*, vol. 25, no. 302, November 1, 1917, pp. 143-146.

AMMUNITION PROBLEMS IN WAR TIME, A. L. Humphrey. *Official Proceedings of the Railway Club of Pittsburgh*, vol. 16, no. 8, September 28, 1917, pp. 298-318, 12 figs.

EFFECT OF AIR CONDITIONING UPON MUNITIONS MANUFACTURE, J. Irvine Lyle. *Journal of the American Society of Heating and Ventilating Engineers*, vol. 24, no. 1, October 1917, pp. 45-53, 8 figs.

## Power Generation

NEW 92,500-HORSEPOWER HYDROELECTRIC PLANT FOR SPAIN. *Electrical Review*, vol. 71, no. 20, November 17, 1917, p. 837.

CEDEGOLO STATION OF THE ADAMELLO POWER DEVELOPMENT IN ITALY, C. A. Tupper. *Electrical Review*, vol. 71, no. 20, November 17, 1917, pp. 838-839, 2 figs.

A COMPARISON OF THE WORKING COSTS OF THE PRINCIPAL PRIME MOVERS, Oswald Wans. *The Journal of the Institution of Mechanical Engineers*, November 1917, no. 7, pp. 531-555, 8 figs.

## Pumps

CHARACTERISTICS AND SPECIFIC SPEEDS OF CENTRIFUGAL PUMPS, F. G. Hechler. *Journal of the American Society of Naval Engineers*, vol. 29, no. 4, November 1917, pp. 673-697, 10 figs.

ONE-HUNDRED-AND-TEN-MILLION GALLON PUMP FOR ST. LOUIS, H. F. Gauss. *Power*, vol. 46, no. 23, December 4, 1917, pp. 752-755, 4 figs. Describes a turbine-driven, 13-stage centrifugal pump having a maximum capacity of 110,000,000 gal. against a head of 65 ft. Under normal conditions, a pump efficiency of 81 per cent is expected, and a duty exceeding 114,500,000 ft.-lb. per million B.t.u.

MERCURY VAPOR PUMPS FOR OPERATING AGAINST HIGH PRESSURES, Chas. A. Kraus. *The Journal of the American Chemical Society*, vol. 39, no. 10, October 1917, pp. 2183-2186.

THE PARALLEL JET HIGH VACUUM PUMP, William W. Crawford. *The Physical Review*, vol. 10, Second Series, no. 5, November 1917, pp. 557-563, 3 figs.

## Railroad Engineering

REFRIGERATOR CARS FOR THE BALTIMORE & OHIO. The Baltimore & Ohio has recently constructed in its own shops some

refrigerator cars that contain interesting features of design.

Contrary to the customary practice, the insulation throughout the car is applied without any air space between the different layers. This was done because it has been found that it is difficult to maintain tight a car with the layers of insulation separated, due to the constant waving of the car. Further, by applying the various layers of insulation directly upon each other, the construction of the car is made less complicated and the insulation is better supported.

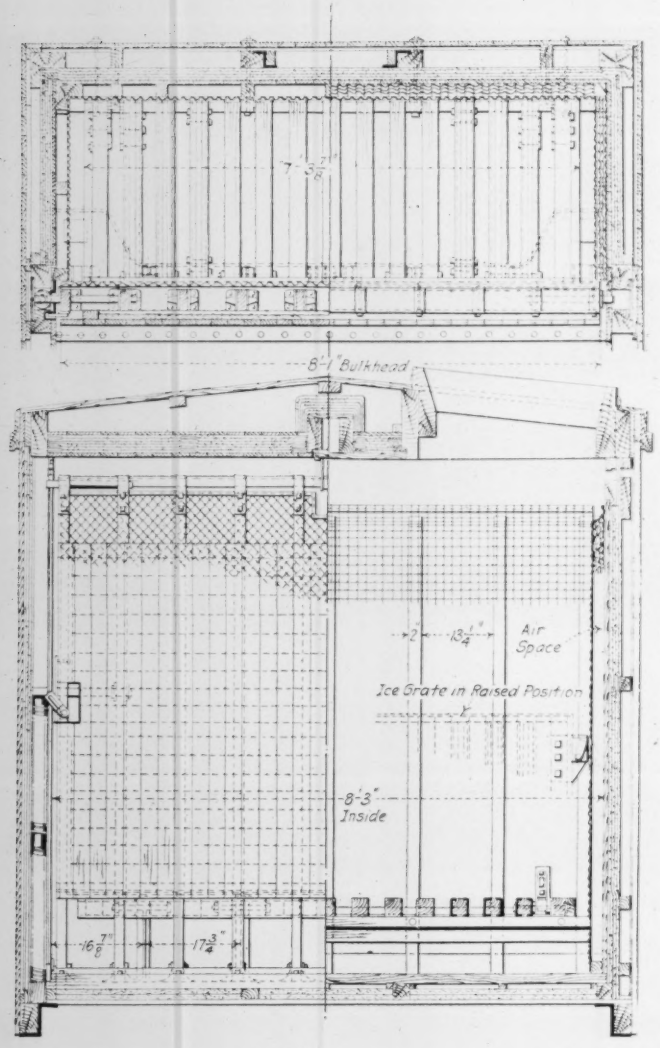



FIG. 3 SECTIONS THROUGH ICE BUNKERS SHOWING INSULATED BULKHEAD

It was the belief of the designers that better refrigeration is obtained if the air in the car has a direct and positive circulation. To secure this, the bulkhead of the ice chamber was made solid, with ample openings at the top and bottom, and the load held above the floor on racks. To obtain greater effectiveness from the ice, a wire netting is provided to hold it, which permits a free circulation of air around it. With the ice thus held away from the sides and end of the car less heat is absorbed through the car walls. The bulkhead is insulated (see Fig. 3) so that it will not transmit heat to the ice, but instead will guide the cold air down to the bottom of the car for circulation. The insulated bulkhead also prevents, to a large extent, the condensation of moisture on the car side of the bulkhead, which is liable to spoil the material placed against it.

The actual method of applying the insulation is shown in Fig. 4. The insulation passes around the corners of the car in continuous strips to better provide a tight insulated joint. At the top the outside layer of insulation is lapped up into the ceiling insulation around the side plate. The insulation of the ceiling is heavier than that on the sides, as it has been found that the absorption of heat is greater on the top of the car than on the sides. Since the weight of the ceiling with the insulation is too great for it to be firmly held by nails, $\frac{3}{4}$-in. to 3-in. support strips are placed at every third carline and are bolted at the carlines by $\frac{3}{8}$-in. bolts countersunk into the carlines.

Special care has been taken to properly insulate the walls surrounding the icebox, and the ice-hatch door is constructed with great care. The ice bunkers have a capacity of 15,000 lb. of ice. (*Railway Age Gazette*, vol. 63, no. 22, November 30, 1917, pp. 981-984, 6 figs., *d*)

STANDARDIZATION VERSUS IMPROVEMENT. "Standardization is a good thing within certain limits, but standards are not an end in themselves. They are only an aid to be applied with discretion." This is the statement made in an editorial article in the *Railway Review*. The writer proceeds somewhat as follows:

The standardization cult may easily become a mere drag on improvement, and in some cases the refuge of mental laziness and torpidity. The standards of today will be the deadwood of tomorrow, unless controlled by brains.

With particular reference to railroad engineering, in some things the advantages of standards are very perceptible. Freight cars travel all over the railroad system and need maintenance repairs wherever they happen to be. The advantage of standardizing parts that must work together, like couplers, and of dimensions and locations, so that interchange-

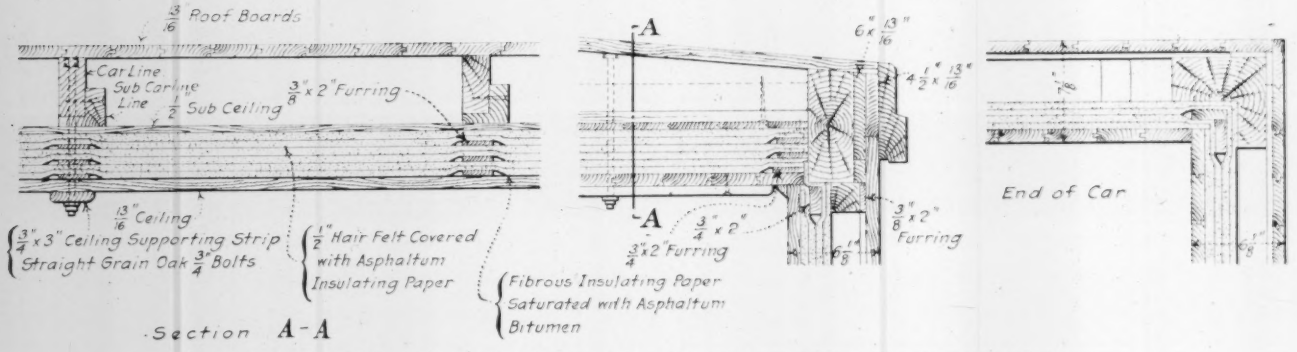



FIG. 4 METHOD OF APPLYING INSULATION TO BALTIMORE & OHIO REFRIGERATOR CARS

ability may be insured, are self-evident, but the freight car of today is not a perfect vehicle, and is in the process of evolution. This evolution can easily conform itself to such standards as will not hinder the way of improvement, but engineering improvement will not cease either by agreement or legislative mandate.

In the case of locomotives there is less real field for standardization as they stay on their own roads. They must operate with different fuels and different waters over varying grades and curves, and are subject to numerous conditions which stationary power plants do not have to contend with.

The best results are to be obtained by designing the machine for the service conditions it is to meet, so that excessive standardization, if applied to locomotives, would militate against ultimate efficiency. (*Railway Review*, vol. 61, no. 19, November 10, 1917, pp. 581-583, *g*)

LOCOMOTIVES OF THE 2-10-2 TYPE FOR THE WABASH. *Railway Age Gazette*, vol. 63, no. 23, December 7, 1917, pp. 1025-1028, 7 figs.

THE 4-4-0 TYPE LOCOMOTIVE IN GREAT BRITAIN. *The Railway Gazette*, vol. 27, no. 20, November 16, 1917, pp. 536-540, 5 figs.

A STUDY OF FRICTION DRAFT GEAR CAPACITY, Louis E. Endsley. *Railway Age Gazette*, vol. 63, no. 20, November 16, 1917, pp. 893-896, 3 figs., 2 tables.

THE ABILITY OF REFRIGERATOR CARS TO CARRY PERISHABLE PRODUCTS, Dr. M. E. Pennington. *The Railroad Herald*, vol. 21, no. 12, November 1917, pp. 276-278, 1 chart.

TRANSVERSE FISSURES IN RAILS, James E. Howard. *Railway Review*, vol. 61, no. 21, November 24, 1917, pp. 644-647. An abstract of this article will appear in an early issue of THE JOURNAL.

REFRIGERATOR CARS FOR THE BALTIMORE & OHIO. *Railway Age Gazette*, vol. 63, no. 22, November 30, 1917, pp. 981-984, 7 figs.

METHODS OF LOADING, BRACING AND STOWING L. C. L. FREIGHT, ATCHISON, TOPEKA & SANTA FE RAILWAY, Charles E. Parks. *Railway Review*, vol. 61, no. 19, November 10, 1917, pp. 576-579, 12 figs.

## Refrigeration

THE SPECIFIC AND LATENT HEATS OF LIQUID AMMONIA, reviewed by H. C. Dickinson. *Refrigerating World*, vol. 52, no. 11, November 1917, pp. 21-26, 9 figs., 4 tables. A summary of the work done at the Bureau of Standards, with a view to determining the physical constants of liquid ammonia.

A FIVE-HUNDRED-TON HIGH-SPEED BOOSTER AMMONIA COMPRESSOR, F. L. Fairbanks. *A. S. R. E. Journal*, vol. 4, no. 3, November 1917, pp. 298-307.

## Steam Engineering

NOZZLE CHARACTERISTICS, G. Flügel. (*Zeits. Vereines Deutsch. Ing.* 61, pp. 650-655, Aug. 4, 1917). Notwithstanding many theoretical and experimental investigations into the question of the expansion of elastic media flowing through nozzles, there still remains a series of technically important phenomena which require explanation. In the present paper the nozzle effect is examined for the case of a medium conforming to given conditions and with unrestricted exit. By nozzle characteristics the author means curves which exhibit the relationship between the reaction force of velocity coefficient at constant initial pressure before the nozzle, and either the final pressure after expansion of the adiabatic exit velocity.

The average velocity first receives attention, and here the existence of the mean active velocity and its relationship to the actual mean velocity and to the square of the mean velocity, is made clear. Nozzles suitably enlarged are next dealt with, the calculation of the respective velocity coefficient being given. It is shown that the curve of velocity coefficient becomes steeper within the critical zone for increasing exit velocity. The author shows how the most favorable form of nozzle may be evolved when the conditions of flow are known. For nozzles of normal cross-section but with too small enlargement, the velocity coefficients may be calculated with perfect accuracy, and with a good approximation for nozzles of oblique cross-section when certain simplifications are made. The striking result is obtained that after decrease of back pressure, the velocity coefficient still grows and reaches its maximum value for high pressures, the worse the nozzle. A limiting inferior pressure is shown for nozzles with oblique section, from which the expansion conforms to other laws as in the intermediate zone. Finally, with nozzles of too great enlargement experiments are quoted showing the improbability of the so-called direct gas impact and an indirect confirmation of this consideration is indicated. The author opines that a better solution may be sought from analogy with incompressible liquids flowing through an enlarged canal. Under this assumption a suitable approximation for the velocity coefficients is given which corresponds better with reality. (*Science Abstracts*, vol. 20, no. 238, section A, October 31, 1917, pp. 451-2)

PURIFYING CIRCULATING WATER FOR SURFACE CONDENSERS, W. Seyffert. (*Ver. d. Elektrizitätswerke*, Mitt. no. 191, April 1917. *Elektrot. u. Maschinenbau*, 35. p. 376, Aug. 5, 1917). Mechanical and chemical impurities in circulating water form more or less rapidly a hard crust in the condenser tubes. The rate of heat transfer is then reduced; so also are the quantity and velocity of water flow. Thus vacuum is lowered and the efficiency of the main engine decreases. Removal of deposits either mechanically or by acid involves interruption of service. It is better and cheaper to eliminate mechanical impurities in settling ponds, and to undertake such chemical purification as may be necessary. The Martin (Berlin) patent clarifier is more convenient than a series of settling ponds. Water enters the funnel-shaped bottom of a vertical container. Any sludge, etc., settles in the funnel-shaped bottom and clear water is siphoned away from the top. Starting is facilitated by connection to a vacuum line; subsequently, with the inlet, outlet and sludge pipe open, the apparatus is entirely automatic. A clarifier with drum diameter of 5 m., capable of dealing with 70 cu. m. of water per hour, occupies 25 to 30 sq. m., including attendance space. Grease, oil, and gas rise to the top and are removed periodically through a special outlet. Tests at the Waldenburg central station showed 83.8 per cent "purification efficiency" for such a clarifier; chemical purification was also necessary in this case. From 11 to 14 kg. of circulating water was lost per kw.-hr. by evaporation in the cooling towers (air temperature — 4.5 deg. to + 11 deg. cent.; circulating-water inlet 24 deg. to 39 deg., outlet 20 deg. to 27 deg.). Due to this evaporation deposits are precipitated on the laths and grooves of the cooling tower. The efficiency of the latter is reduced and the laths are endangered.

A Reisert water purifier (50 cu. m. per hr.) operating on the lime process is installed at Waldenburg. The apparatus includes a cylindrical reaction tank, a distributor, two Der-

vaux conical saturators, and a gravel filter bed, 12 sq. m. in surface. The whole equipment is in the open and can be operated even when the atmospheric temperature is — 25 deg. cent. Water is circulated by an electrically driven pump. A spray equipment, operated by compressed air, is used to wash the filter. This purifying plant has been in use since 1911, and has reduced the cost of cleaning condensers from 28-42 M. ($7.00-$10.50) once a fortnight to 15-20 M. ($3.75-$5.00) once in six months. During 1915 the total cost for purifying the circulating water was 1.61 pf. per cu. m. of water, or 0.03 pf. (0.0072 cent) per kw.-hr. generated. (*Science Abstracts*, vol. 20, no. 238, section B, October 31, 1917, p. 357)

CLEANING CONDENSER TUBES IN THEIR PLACE WITH HYDROCHLORIC ACID, G. M. Robertson. Description of a method for the removal of scale in condensers where the scale is of a limy nature.

Tests were made with the condenser containing 4725 brass tubes $\frac{5}{8}$ in. inside diameter, $\frac{3}{4}$ in. outside diameter, 14 ft. long, fitted in brass tube plates with the usual tape packings and ferrules. The water box is cast iron and the cover is mild steel. The condenser was frequently scraped with different types of scrapers, but this removed only the softer stuff while the hard lime scale remained. If scrapers are made tight

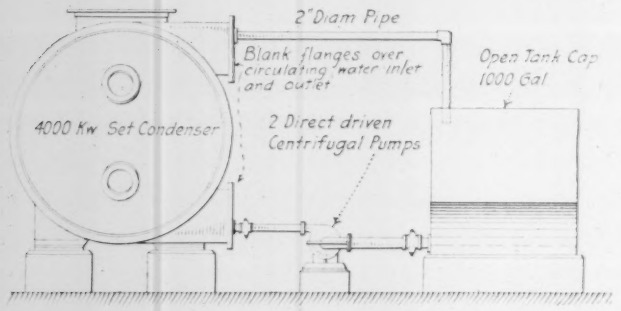

2" Diam Pipe
Blank flanges over circulating water inlet and outlet
Open Tank Cap 1000 Gal
4000 Kw Set Condenser
2 Direct driven Centrifugal Pumps

FIG. 5 CLEANING CONDENSER TUBES BY DILUTE HYDROCHLORIC ACID

enough and sharp enough to remove some of the hard scale then the tubes are apt to be damaged.

An attempt was made to remove this scale with hydrochloric acid of specific gravity 1.150. Preliminary tests have shown that pieces of tube and packing were undamaged after remaining in an acid solution of five parts of water to one part of acid for 24 hours. It was also found that one ounce of acid dissolved half an ounce of scale, no matter what the strength of the solution was.

The test itself was carried out in the following way. First, a plain $\frac{1}{2}$-in. rod was pushed through every tube to make sure that they were clear. The water box and condenser covers were chipped clear of scale and the whole washed down with a hose. All the iron portions were given one coat of Bitmo solution to preserve them from the acid. The covers were put on.

The condenser was then filled with water from the 1000-gal. tank, Fig. 5, until the condenser was full and the tank had water just over the suction of the pump. The steam side of the condenser was also filled with water and a $\frac{3}{4}$-in. steam pipe fitted to the bottom of the condenser to warm the water, as acid is more active when warm. The steam was kept on the condenser for four hours, until the condenser was warm to the hand. Circulating was started from the tank through the condenser at 7.00 a.m., and one carboy of acid was added to the tank every twenty minutes until 10:30 a.m., one ton of acid being used. No more acid was added after 1:00 p.m. At 1:00 p.m. the pump was stopped, and the solution run into the tank through the pump until the top inspection door was clear. The top half of the condenser was then inspected through the inspection door, and some of the ferrules were showing clean. The inspection door was put on, and circulating started again, and more acid added to the tank at the same rate, and another ton supplied to tank by 5:00 p.m. The circulation was kept up until 7:00 p.m., when the solution was lowered again, and the top half again inspected. All the ferrules were showing clean, and there were only a few places between the ferrules where scale was still lodging. The inspection door was closed, and circulating restarted, and kept up until 11:00 p.m. The remaining solution was then thrown away to the vlei, from which our circulating water is taken, and water supplied to tank and circulated through the condenser to the vlei for five or six hours to wash away any acid that remained. The condenser covers were then taken off and the face of the tube plates, and as much through the tubes as possible, washed down with a hose with $\frac{5}{8}$-in. nozzle with about 30 lb. pressure. A few ferrules were leaking slightly at the threads; tightening up the ferrules stopped the leaks. There were no tubes leaking.

A measured sample of the solution flowing from the condenser to the tank was taken at 5:30 p.m. and analyzed for wastage of the brass tubes and ferrules. It was estimated that 5 lb. of copper from the tubes and ferrules had been dissolved. (The total weight of the copper was close to 34,000 lb.)

When the condenser was washed out after cleaning with acid, it was found that, as regards the iron parts, the Bitmo solution had been washed off in only a few small places, apparently where it had been painted over rust, but the iron work was not harmed. While the ferrules were clean when the condenser was washed out a considerable quantity of scale came out of the ends of the tubes, showing that the acid might have been kept circulating for some time longer. The scale which remained had been loosened, however, and was easily washed out.

In using the acid, it was poured from the carboy into an enameled jug holding about two gallons, and wet cloths were tied about the men's hands in case of spillage. Lime or lime water should be kept handy for the same emergency.

The 2-in. pipe shown from the top of the condenser might have been slightly larger to allow a clear escape to the gas. The circulating pump had a capacity of 2000 gal. per hour.

The cost of acid and preparing the condenser was £50 (about $250) and the whole work paid for itself in one week by the saving in coal due to improved vacuum.

Calcium and magnesium carbonates composed the larger portion of the scale. In addition, ferric oxide and silica were fairly abundant. (*The Journal of the South African Institution of Engineers*, vol. 15, no. 11, June 1917, pp. 276-279, 3 figs., *dp*)

A GAS-FIRED BOILER INSTALLATION, J. C. Hobbs, Mem.Am. Soc.M.E. Description of a boiler plant located in the basement of the William Penn Hotel, in Pittsburgh, which, in addition to generating power and heat for the hotel itself, also serves for heating an adjacent building.

Some of the features of construction are of considerable interest, as showing how some difficult problems of design have been effectively overcome.

The conditions affecting the construction and operation were rather severe. The plant is located under the hotel, the boiler-room floor being 50 ft. below the street surface. The plant must be operated noiselessly and produce no dirt.

The height of the stack has been fixed by the height of the hotel at about 350 ft. To take up the difference between the expansion of the steel stack and that of the building, the stack was made in short sections and supported from the steel frame of the building.

Because of the lack of area a rectangular stack was used, one joint to each two floors, and the joints instead of being left open were sealed by the special sand and asbestos joint shown in Fig. 6. Brick insulation was not used, because in the rectangular form the heat would have caused it to cave in. Instead asbestos insulation was used, as being thinner, smoother and giving more area.

As regards breeching, the principal points are the easy bends used, the method of caring for expansion and the application of the insulation.

Fig. 7 shows the details of the type of nozzle connection designed to permit expansion. The insulation is applied to the inside of the nozzle and to both the inside and outside of the breeching proper instead of on the outside only. It was deemed that the latter, while fairly effective as an insulation to reduce radiation, is dangerous, as it is possible even with a first-class boiler setting to have a temperature high enough to collapse a steel breeching if the heat is held in by the outside covering.

As regards boilers, the first ones installed were of the longitudinal type, B & W, rated at 600 hp., and were baffled with a special vertical baffle built of a high-temperature cement. The economic results obtained with this cement baffle were very good at first, but the cement soon began to fall out and the stack temperature to go up. Hence, a change was made to the horizontal-type baffle, shown in Fig. 6 (as applied to a cross-drum boiler having the same tube arrangement).

Careful consideration of local conditions has shown the advisability of using gas fuel, and a special gas burner, shown in Fig. 8, was developed. This burner permits an absolute control of the quantities of gas and air and likewise a thorough mixing of the two before their entering the furnace, without allowing the burner to fire back. Although the gas and air are kept separate up to within a few inches of the furnace, a mixture with a very fine subdivision is made, the gas and air being separated only by the walls of the small pipe.

No attempt has been made to make the gas and air control entirely automatic. It was felt that neither the air nor the gas should be controlled independently by an automatic device. It has been found that the amount of time required for gas and air adjustments is small, and it is believed that the advantage of the simplicity is more than enough to offset the costs of hand operation.

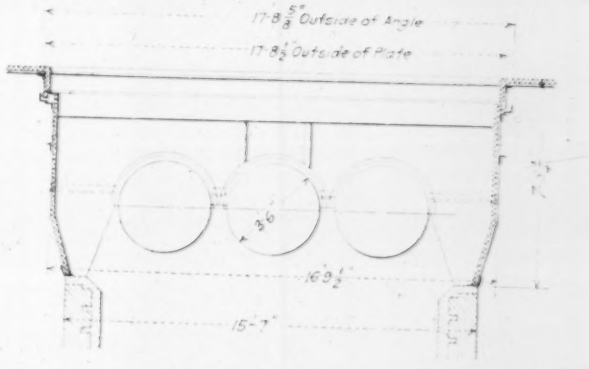



FIG. 6 DETAIL OF NOZZLE CONNECTION IN THE BREECHING

The proper adjustments to determine the correct ratio between the quantities of gas and air are determined by the use of a single U-tube. This, as will be noticed in Fig. 8, is connected direct to the gas chamber between the control valve and the mixing nozzles. A schedule of the correct position of the air damper has been determined by special and operating tests. For the sake of simplicity the damper position is indicated by the same figure which represents the gas pressure. The quantity of air is determined by the position of the air damper because the drop in pressure between the boiler room and the furnace is maintained constant at one-tenth of an inch of water. This figure was decided upon as a compromise between a high draft loss through the burner with its disad-

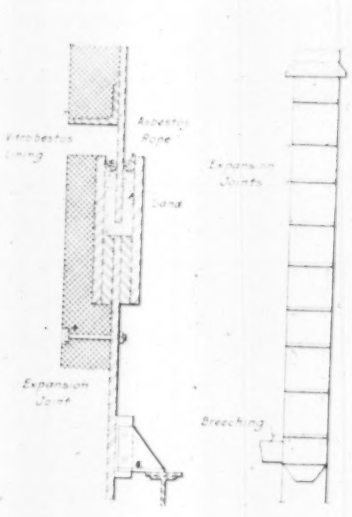



Fig 7

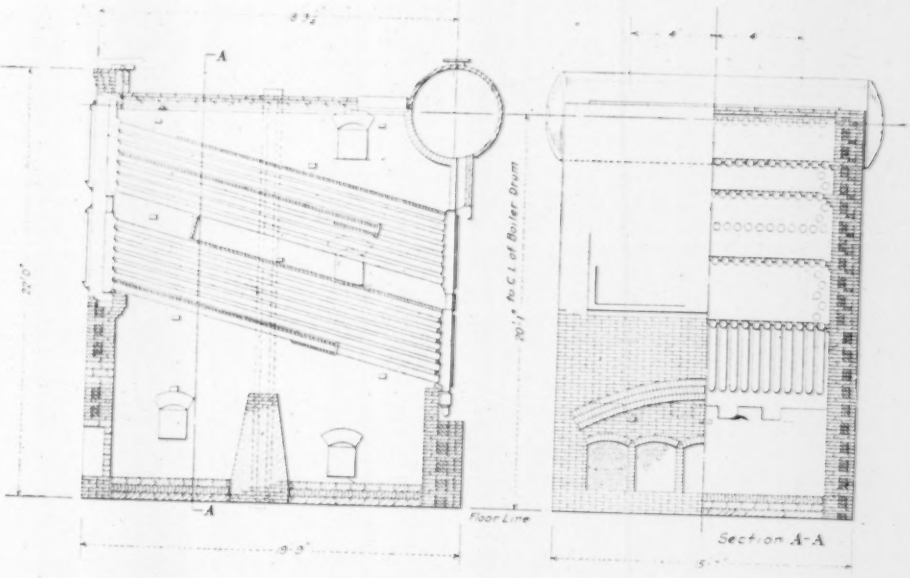



Fig. 8

FIG. 7 ARRANGEMENT AND DETAIL OF WILLIAM PENN HOTEL STACK

FIG. 8 SYSTEM OF BAFFLING AND WALL CONSTRUCTION FOR GAS-FIRED BOILERS

vantage of causing an increased leakage loss through the setting, and a very low draft loss, a slight change of which would cause a large percentage of change in the quantity of air.

The brick work is simple, no checkerwork being used. With the horizontal baffling a medium-height bridge wall with the slightly raised pillar in front of each burner is all that is used, as shown in Fig. 9. The burner, as adopted, is in reality a multiple bunsen burner. Each burner consists of forty-eight 7 16-in. nozzles delivering gas from the manifold to the $2\frac{1}{2}$-in. air openings.

As regards the economic performance of the plant, only the average monthly efficiencies are given in the paper. They vary from 77.2 per cent in November 1916 to 85.2 per cent in January 1917, the lower efficiencies being due to radiation loss at light loads. These figures do not represent a few hours or even a day, but are the average efficiencies for the entire month and show what has actually been accomplished by the regular operators.

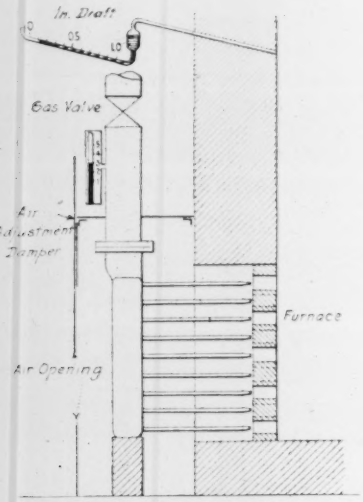



FIG. 9 ARRANGEMENT OF GAS BURNER

The writer ascribes the success of the installation to the following three factors:

1 The cutting out of the loss of draft through the damper and substituting the resistance of a longer path through the boilers, obtaining better heat absorption
2 The design of a durable burner which will give correct mixture under all conditions
3 The maintenance of the proper interest of the operators.

In the discussion which followed, L. C. Frohrieb, of the Federal Engineering Company, Pittsburgh, Pa., told about his tests of a 260-hp. water-tube boiler using natural gas for fuel in which an efficiency of 80 per cent was obtained. This was a three-pass horizontally baffled boiler with "C" tile on the lower row. One of the features was that there was no measurable draft loss through the entire setting, which was due to the fact that the setting was designed for coal.

A. G. Davis, of the Philadelphia Company, Pittsburgh, communicated a simple method of calculating the volume of flue gas which will be given over in the combustion of a unit volume of natural gas. The only data necessary for this calculation are an analysis of the natural gas to be used and a knowledge of the volume required. This method is based on an estimation of the oxygen required to burn the hydrocarbons present in the natural gas. (*Proceedings of the Engineers' Society of Western Pennsylvania*, vol. 33, no. 7, October 1917, pp. 421-456, 12 figs., *de*)

STEAM BOILERS AND ECONOMIZERS, M. R. Schulz (*Ver. d. Elektrizitätswerke*, Mitt. No. 189, March 1917. *Elektrot. u. Maschinenbau*, 35, p. 243, May 20, 1917). No boiler installation with natural draft can yield a higher thermal efficiency than 82 to 83 per cent; from 6 to 13 per cent of the value of the coal burnt goes to maintain the chimney draft, and therefore cannot be utilized in any other manner. With forced draft, up to 85 to 86 per cent of the thermal value of the coal may be utilized; if more than this be utilized, it is offset by power expenditure on the draft fan. Three tests on an inclined-tube boiler of 1000 sq. m. heating surface, with artificial draft and using coal of 7490 kg. cal. per kg. (13,480 B.t.u. per lb.), gave the following ranges of heat-balance percentages: Steam raising and superheating, 75.6-72.9; economizer, 11.1-11.3; total useful heat, 84.2-86.7; chimney loss, 10.1-11.3; incomplete combustion and radiation (boiler and economizer), 3.2-4.5 per cent; fan, 20-23 b.hp. The author finds that the principal error in steam trials is in determining flue-gas temperature, and is generally attributable to unsuitable pyrometer dimensions. As a check on economizer test results and claims, it may be taken that for 1 deg. temperature rise in feedwater in the best economizer, with no in-leakage of cold air, the temperature of the flue gases must be higher by 1.5 deg. cent. for 8 per cent $CO_2$ content; 2 deg. for 10 per cent, 2.5 deg. for 12 per cent, and 2.75 deg. for 13 per cent $CO_2$ content. In cast-iron economizers the difference is still greater. With a temperature gradient from 347 deg. to 233 deg. cent. (i. .e., 114 deg.) and 10.6 per cent $CO_2$, feedwater could not be raised 92 deg cent. in a cast-iron economizer; neither could water be warmed 89 deg. cent. in a wrought-iron economizer. Heat value at economizer outlet is 18.5 per cent with cast-iron, and 17.9 per cent with wrought-iron, apparatus. It does not follow that the lower the flue-gas temperature on leaving the boiler, the higher the efficiency of the utilization of coal. The $CO_2$ content as well as the gas temperature behind boiler or economizer must be considered. Tests on a water-tube boiler with Düsseldorf cast-iron economizer and forced draft showed 79 per cent thermal efficiency without economizer and 83.3 per cent efficiency with economizer. The author shows that flue-gas temperatures before and behind the economizer were measured inaccurately and losses were estimated too high. The gas temperatures were measured at unsuitable positions, too little attention was paid to $CO_2$ analysis, and it was overlooked that thermal value changed with decrease in $CO_2$ content, and that the $CO_2$ content was much lower at the chimney outlet than at the boiler outlet. The difference is 1 per cent and 3 per cent with cast-iron economizers of 144 and 250 sq. m., and increases considerably with artificial draft.

Boiler efficiency cannot be improved simply by forcing the draft. (*Science Abstracts*, Section B, Electrical Engineering, no. 238, October 31, 1917, pp. 354-355 *g*)

ETUDE SUR LES CAUSES DE LA CORROSION DES CHAUDIERES À VAPEUR, Ch. Chorower. *Revue Générale de L'Electricité*, tome II, no. 20, November 17, 1917, pp. 775-779, 2 figs., 2 tables. A discussion of the various causes of corrosion of steam boilers.

CAPITALIZED VALUE OF ONE-TENTH OF AN INCH OF VACUUM, C. H. Baker. *Power*, vol. 46, no. 23, December 4, 1917, pp. 762-763, 3 figs. Formulae and charts are given for calculating the capital that may be economically invested in condenser equipment for each one-tenth of an inch of vacuum gained with steam turbines. Problems are also worked out to show the application of the charts.

THE DETERIORATION OF CURTIS-RATEAU TURBINE BLADING, A. Fenwick. *The Journal of the South African Institution of Engineers*, vol. 15, no. 11, June 1917, pp. 284-287.

ELECTRIC HEAT STORAGE IN BOILERS. *Engineering*, vol. 104, no. 2705, November 2, 1917, pp. 468. Description of an electric steam generator which has been in use for some years in considerable numbers in many Italian works. In this generator the ohmic resistance of the water itself is used for the transformation of electric energy into steam. It is known as the Revel steam generator.

DIE STÜTZUNG VON DAMPFKESSELN UND VON WASSERLEITUNGEN, E. Hohn. *Schweizerische Bauzeitung*, Band 70, no. 18, November 3, 1917, pp. 207-210, 6 figs. Discussion of the methods of supporting steam boilers and water piping.

THE FORM OF BOILER DRUMS, Robert Cramer. *Power*, vol. 46, no. 20, November 13, 1917, pp. 662-664, 8 figs. Discussion of the shape of boiler drums with the view to making a boiler capable of withstanding modern high steam pressures.

NÅGRA ANVISNINGAR FÖR UTFÖRANDET AV VÄRMETEKNISKA BERÄKNINGAR, Alf Grabe. Bihang till *Jern-Kontorets Annaler*, Arg. 18, no. 9, September 15, 1917, pp. 401-425, 3 tables.

NOTE ON THE SPECIFIC HEAT OF WATER, W. R. Bousfield. *Proceedings of the Royal Society*, Series A, vol. 93, no. A 655, Mathematical and Physical Sciences, pp. 587-591. A brief abstract of this paper will be given in an early issue.

## Thermodynamics

HEAT TRANSFER FROM AIR TO PIPES, Charles H. Herter. It appears that opinions regarding the rate of heat transfer from air to pipes differ considerably, and the writer cites a number of references showing a variation in $k$ (coefficient of heat transfer from air to pipe in B.t.u. per hr., per sq. ft. of air contact surface, per deg. fahr. mean temperature difference between air and surface) from 13 to 1 B.t.u.

J. E. Seibel stated in 1916 that German engineers use the following values of $k$:

Air through metal to air.....1.20 to 1.70 B.t.u.
Water through metal to air.....2.15 to 3.15 B.t.u.

He also states that for ammonia vapor through iron coils to air, $k$ is roundly estimated at 10 B.t.u., but does not explain why an ammonia-cooled pipe should cool air at a four-times greater rate than a brine-cooled pipe. In fact, the writer questions the existence of such a difference.

The writer also questions the correctness of Siebel's statement repeated in Marks' Mechanical Engineers' Handbook to the effect that 260 to 300 ft. of 1¼-in. pipe per ton refrigeration is a liberal allowance. He does not believe that this is liberal, because even with $k$ as high as 2.5 B.t.u., the necessary temperature difference will be 42.4 deg. with 260 ft. and 36.7 deg. with 300 ft., and it is evident that the allowance made for pipe per ton should be doubled for economical operation.

R. W. Leonard, in a paper before the Canadian Society of Civil Engineers, October 1904, describes some tests on loss of heat from iron pipe with pipes exposed in vertical position to air outdoors in the shade and filled with hot water. From the data given, Mr. Herter calculated the value of $k$, and found it to be from 1.894 to 3.55 B.t.u. for pipes of various dimensions and various temperatures of air. The last value is for pipe exposed to wind blowing at 480 to 720 ft. per min.

In tests made by the Armstrong Cork Company, values were obtained varying for different conditions of test from 1.8 to 2.18 B.t.u. Various values of $k$ are shown in Fig. 10.

Curve 1 represents values of $k$ given in Kent's Mechanical Engineers' Pocket-Book, 1912, p. 677, for indirect hot-water radiators, where the mean temperature difference is seldom less than 100 deg. fahr. This curve probably applies to nested or deep radiators, the heat-transmitting capacity of which is only moderately high.

Curve 2 represents values obtained by passing known volumes of air through a boiler tube surrounded by steam. The formula applying to this curve is:

$$k = \frac{1}{0.026 + \frac{187}{v}}$$

where $v$ = air velocity in ft. per min.

Curve 3 is based on data derived from Lorenz and Heinel. It gives the value of $k$ for ordinary *brine pipes* to air, as in dry air coolers or coil bunkers with forced air circulation. This curve is intended for velocities exceeding 200 ft. per min., where, according to the authors, the influence of temperature

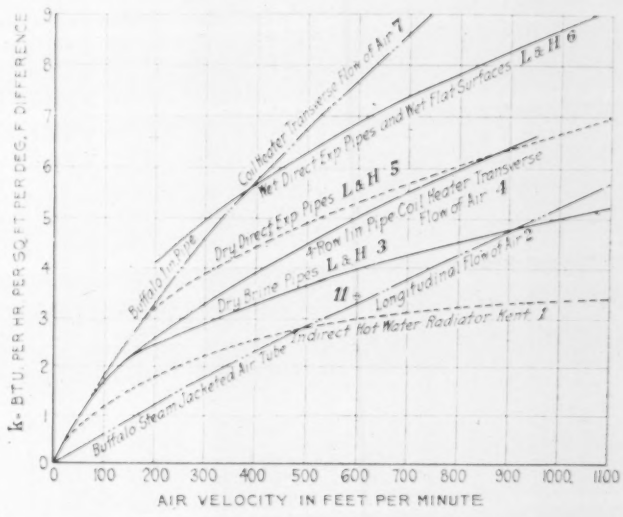



FIG. 10 HEAT TRANSFER CLAIMED BY VARIOUS INVESTIGATORS UNDER CONDITIONS INDICATED WITH AIR IN FORCED CIRCULATION

difference disappears. The following formula for this curve is given in the original:

$$k = 2 + 10\sqrt{v}$$

in calories per hour per square meter per degree centigrade, where $v$ = velocity in meters per second.

In English units, writing $v$ in ft. per min., this formula would read:

$$k = 0.41 + 0.1458\sqrt{v} \text{ B.t.u.}$$

Curve 4 is taken from H. Recknagel, and from Rietschel, 1909. Up to 300 ft. per min. the values of $k$ are those applying to single hot-water radiators. Above 300 ft. they apply to four-row 1-in. steam-coil heaters with the air passing through the heater perpendicular to the pipes.

Curve 5 represents values of $k$ for *dry direct-expansion pipes*, expressed by Lorenz and Heinel by the following formula in metric units:

$$k = 16 \times \frac{2 + 10\sqrt{v}}{12} \text{ calories}$$

which, in English units, is equivalent to

$$1.333 \times (0.41 + 0.1458\sqrt{v}) \text{ B.t.u.}$$

Curve 6, giving values of $k$ with *wetted direct-expansion pipes* as well as with wetted flat surfaces, is based on the following formula given by Lorenz and Heinel:

$$k = 2 + 18\sqrt{v}$$

in calories per hour per square meter per degree centigrade, of which one unit = 0.204817 B.t.u. per hr. per sq. ft. per deg. fahr.

Transformed into English units, this last equation becomes

$$k = 0.41 + 0.2626\sqrt{v}\ \text{B.t.u.}$$

Curve 7 represents the results of tests made on standard four-row indirect or *coil pipe heaters* composed of 1-in. pipes placed on $2\frac{5}{8}$-in. centers, air flowing transversely through the heater. The figures of $k$ obtained agree with the following formula:

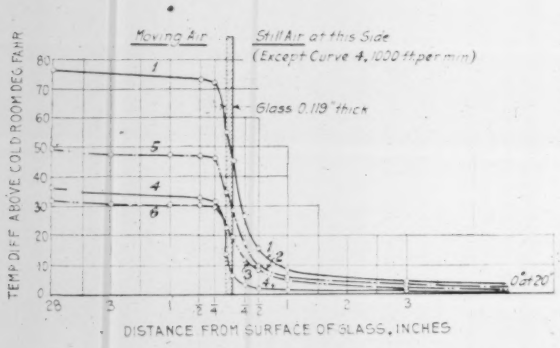

Moving Air
Still Air at this Side
(Except Curve 4, 1000 ft per min)
Glass 0.119" thick
TEMP DIFF ABOVE COLD ROOM DEG FAHR
DISTANCE FROM SURFACE OF GLASS, INCHES
0 at 20

FIG. 11 TEMPERATURE GRADIENT ON EACH SIDE OF PANE OF GLASS

$$k = \frac{1}{0.0447 + \frac{50.66}{v}}\ \text{B.t.u.}$$

where $v$ = velocity of air through the clear area of the heater in feet per min. Up to 1200 ft. per min. they can be expressed by the approximate formula:

$$k = k_0\left(\frac{v}{r}\right)^{2/3}$$

which proves that up to 1200 ft. $k$ varies approximately as the *two-thirds power of the velocity*, instead of as the *square root of the velocity*, as has frequently been stated by other investigators.

The writer also gives a simple equation representing the relation in B.t.u. per hr. per sq. ft. per deg. fahr. temperature difference in the case of flow of heat from one medium to another through metal walls of a pipe, and another equation covering the case of a pipe coated with paint or ice on its outer surface and a layer of congealed oil or grease on the inner surface.

He then proceeds to a discussion of tests by Nusselt previously reported in the Journal of the Society of German Engineers, 1909.

In the discussion which followed, F. L. Fairbanks, Mem. Am.Soc.M.E., called attention to the fact that it is quite impossible to secure an accurate heat-transfer test which will be constant, owing to the fact that all factors are variable, and the best thing is to secure some approximate figure which will cover the maximum and minimum conditions in refrigerating plants.

In refrigerating practice the tendency has been in some cases to use the minimum amount of surface that would do the work, and usually the lack of condenser surface has been dearly paid for in operation, because of the high pressure necessary to condense a given unit of gas. The writer has found it excellent economy to have surplus cooling and condensing surface to enable a plant to maintain reasonably high efficiency and economy in spite of the fluctuations which are bound to occur under the ordinary commercial operating conditions.

A. J. Wood and R. B. Fehr, Members Am.Soc.M.E., have discussed the factors involved in heat transmission from air to pipes and have classified these factors under the three fundamental heads of conduction, convection and radiation.

Tests have been carried out by the writers at Pennsylvania State College with the ultimate purpose of establishing constants for these factors. One of the phases of this investigation is the determination of temperature gradients. The importance of it lies in that the amount of heat emitted by a pipe, for example, is independent of the conditions prevailing inside the pipe, provided the surface temperature is the same for different cases, such as gas through metal to gas or liquid through metal to gas.

Fig. 11 shows the results of a series of investigations on the distribution of the temperature drop from the inside of the test box through a pane of glass to the outside (cold) room. The air inside the box was agitated by an electric fan, while the air in the cold room was "still" (with normal convection) except for curve No. 4 as noted on the diagram. These test results, as obtained by electric-resistance thermometers, bring out the following: (*a*) That the "air films" offer by far the greater amount of resistance, as indicated by the large temperature drop on both sides; (*b*) that the glass, indicated by the small temperature drop, offers but a very small part of the total resistance to the flow of heat; (*c*) that the effect of moving air causes a marked change in the temperature drop on the two sides. (*A. S. R. E. Journal*, vol. 4, no. 3, November 1917, pp. 308-332, 6 figs.)

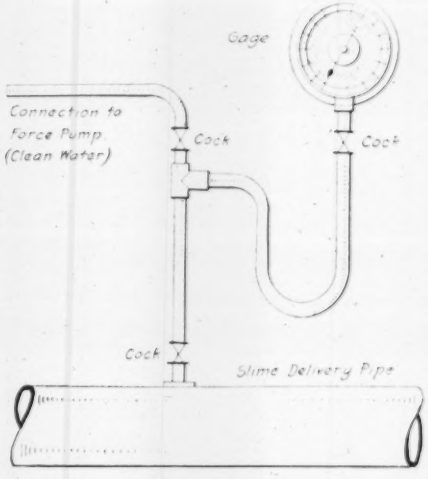



FIG. 12 DEVICE FOR MEASURING SLIME PRESSURE BY BOURDON GAGE

## Varia

FRICTION OF SLIME PULP IN PIPES, E. J. Laschinger. Data of some tests on the friction of slime pulp in steel pipes. The matter is of importance on the Rand, since in nearly all reduction plants there the slime is handled in pulp form by means of centrifugal pumps and piping.

The slime pulp consists of finely comminuted particles of rock (200 mesh and less) mixed with water in proportions

varying from 1 to 1 down to almost pure water. The solid particles, for the most part, consist of sandy or clayey constituents which are to a large extent colloidal, and fine, sharp particles of quartz which are crystalline. The fact that the interior of the pipes remains clean would indicate that the friction must be quite considerable, but not excessive, as proved by the very long life of the pipes.

At the beginning of the tests an initial difficulty had to be overcome. The pressures at various points in the pipe line were taken by means of the ordinary bourdon gages, mounted on the usual U-tubes screwed into the pipe. Owing to the sludgy nature of the thick slime pulp, it was found that the gages did not register the pressure correctly, which was due to a plug of solid matter forming somewhere in the U-tube, and interfering with the free transmission of pressure in the pipe to the gage. This was overcome by adopting the device shown in sketch, Fig. 12. The U-tube was filled with clean water at the start and before every gage reading clean water was forced through the gage connection by means of a hand pump, so as to make sure that the whole connection was clear of slime. In this way reliable and consistent readings were obtained.

The paper gives complete data obtained in the test. Only some of these, however, can be reported here.

It was found that the length of piping which would give a friction head equivalent to the velocity head in the case of the long middle section with only one bend is

$$L = \frac{D}{f}$$

where $L$ = length in ft.

$D$ = diameter in ft.

$f$ = coefficient of friction = 0.0183 in this case.

In another place the figure 0.0177 is given for the overall coefficient of friction. On the whole, it has been found that the friction head for slime is about 13½ per cent less than for water. This latter figure has been confirmed in another series of tests with comparatively thicker pulp.

Since the friction head of ordinary slime pulp (measured in feet of slime) appears to be less than friction head of water (measured in feet of water), and since the pipe for the discharge of slime may have to be used for discharging water, a safe rule to the designer is to specify the pump speed, so as to elevate water to the required height, plus the friction in the pipe due to water, and the power of the motor driving the pump to elevate slime to about the same height. In practice this will mean a motor of about 50 per cent greater power than required for water pumping.

A further point to be borne in mind is to design the piping as straight as possible, avoiding sharp elbows, and particularly vertical drops of more than 20 ft.

In choosing a suitable size of piping, the velocity of flow should not be less than 4½ ft. per sec., and in most plants the velocity is from 6 to 7 ft. per sec. (*The Journal of the South African Institution of Engineers*, vol. 15, no. 11, June 1917, pp. 279-283, 1 fig., *e*)

DRAFT AND ENROLLMENT IN ENGINEERING SCHOOLS. In order to gage the effect of the draft on engineering schools, the *Engineering News-Record* sent a letter to 92 institutions requesting information as to the number of students enrolled at the beginning of the scholastic year for the period from 1912 to 1917 inclusive.

The data collected showed several interesting factors, among them the effect of the depression of 1914 upon enrollment and the remarkable increase in the number of students taking a chemical-engineering course. It was also found that in some schools the senior and junior classes were cut as much as 60 per cent by the operation of the selective draft and through voluntary enlistment. (*Engineering News-Record*, vol. 79, no. 22, November 29, 1917, pp. 1001-1002, 3 figs., *g*)

A NEW AND NOVEL SYSTEM OF VESSEL UNLOADING. *Railway Age Gazette*, vol. 63, no. 23, December 7, 1917, pp. 1033-1034, 4 figs. Description of the Baltimore pier and its system of vessel unloading recently constructed by the Baltimore & Ohio Railroad.

CATENARY OVERHEAD CONSTRUCTION, AN INTIMATE STUDY OF THE DESIGN OF THE OVERHEAD SYSTEM FOR THE MONTREAL TUNNEL AND TERMINAL OF THE CANADIAN NORTHERN RAILROAD, W. C. Lancaster. *Electric Railway Journal*, vol. 50, no. 23, December 8, 1917, pp. 1024-1029, illustrated.

ENGINEERING GRADUATES AND INDUSTRIAL DEMANDS, L. W. W. Morrow. *Engineering News-Record*, vol. 79, no. 24, November 13, 1917, pp. 1109-1112.

THE "RATIO" CHART FOR PLOTTING STATISTICS, Irving Fisher. *Efficiency Society Journal*, vol. 6, no. 11, November 1917, pp. 562-586, 11 figs.

WATER-TIGHT DOORS, Eng.-Lieut. I. Toro. *Transactions of the Institute of Marine Engineers*, vol. 29, October 1917, pp. 219-233, 1 fig.

IMPROVED ENGINEERING LABORATORIES INDICATE MODERN EDUCATION TREND. *The Iron Trade Review*, vol. 71, no. 21, November 22, 1917, pp. 1104-1105, 9 figs.

WOMEN IN INDUSTRY, Alex. Moss. *Coal Age*, vol. 12, no. 21, November 24, 1917, pp. 888-889, 2 figs.

L'UTILISATION DES MUTILÉS POUR L'ORGANISATION DU TRAVAIL, Ch. De Freminville. *Revue de Métallurgie*, 14e Annee, no. 4, July-August 1917, pp. 586-591. Discussion of the problem of employment in industries of cripples.

WOMEN IN INDUSTRY. *Cassier's Engineering Monthly*, vol. 52, no. 3, September 1917, pp. 174-185.

DESIGN OF SPECIAL SLIDE RULES, A. Lewis Jenkins. *Industrial Management*, vol. 54, no. 2, November 1917, pp. 241-248, 15 figs. (Part 1; to be continued.)

### Charts

CHARTS SHOWING CANADIAN PACIFIC OVERHEAD CONSTRUCTION, W. C. Lancaster. *Electric Railway Journal*, vol. 50, no. 23, December 8, 1917, p. 1028.

CHART OF MAXIMUM LIVE-LOAD PIER REACTIONS FOR RAILROAD BRIDGES, F. R. Sweeney. *Engineering News-Record*, vol. 79, no. 24, December 13, 1917, p. 1098.

CURVES FOR WOVEN AND WRAPPED HOSE, WITH SULLIVAN FITTINGS, SHOWING DROP IN PRESSURE PLOTTED AGAINST AIR DELIVERED AT DIFFERENT PRESSURES. *Western Engineering*, vol. 8, no. 11, November 1917, p. 435.

## CLASSIFICATION OF ARTICLES

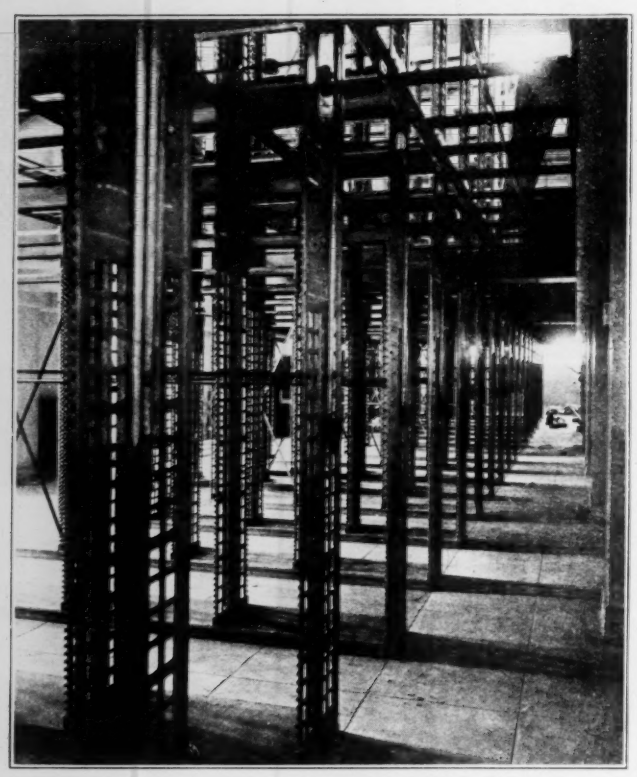
Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer. Opinions expressed are those of the reviewer, not of the Society. The Editor will be pleased to receive inquiries for further information in connection with articles reported in the Survey.

# LIBRARY NOTES AND BOOK REVIEWS

*ARTICLES of interest from the Library of the four Founder Societies, selected list of accessions during the month, and reviews of books of special importance prepared by members of the A.S.M.E. and others particularly qualified.*

THE illustration shows the new stack and work room, occupying the fourteenth floor of the United Engineering Society Building. This room, which has just been completed, will provide much needed accommodation for the book collection, which has outgrown the shelving originally provided and is now crowded to a point that interferes with prompt service.

The new stack will accommodate about 67,000 volumes, but as the Library has transferred one-half of the twelfth floor to the Founder Societies for storage room, the net gain in



PART VIEW OF NEW STACK FLOOR

shelving is only about fifty per cent of this amount. It will be possible, however, to erect additional book stacks in this room to a total capacity of approximately 100,000 volumes, which will care for the Library for some years.

The room is unusually well provided with daylight and an adequate system of electric light is being installed. No partitions have been built between the stacks and the space reserved for work rooms, thus permitting easy rearrangement at any time to meet changing requirements.

The stacks at present installed were formerly used in the Library of the American Society of Civil Engineers, and were very generously presented to us by the Society. The gift was an especially acceptable one, as it has saved not only the cost of a new stack, amounting to several thousand dollars, but also the long delay which would have been experienced in obtaining new construction at this time.

It is hoped that the new stack will be in use this month. It will enable the Library to arrange its books in better order, thus making the service to readers better. The vacated space on the twelfth floor will at the same time provide storage space for publications which is sadly needed by the Founder Societies.

### WAR LIBRARIES

The libraries established by the American Library Association at the Army training camps are filling a definite want by providing reading for the men and officers. The demands made on them, however, are so broad in scope that it is impossible to fill them all. Technical magazines are much appreciated, as well as those of literary interest.

The following communication from a corporal in training at Camp Wadsworth shows what is needed:

"I am a Civil Engineer and would like to be kept in touch with that profession. A periodical that I would like to read is the *Engineering News-Record*. As I am a railroad man I would also like to see the *Railroad Magazine*.

"I have also a friend in this Company with me who is a car tracer for a railroad corporation. He would like to get any books on the traffic end of railroading. If you wish, you can send anything in this line to the addresses below and we would be very grateful for your kindness."

Anyone wishing to meet this want can do so by sending the magazines to the Camp Librarian, Camp Wadsworth, Spartansburg, S. C. Similar gifts of technical journals would undoubtedly be appreciated by the men at other camps.

### NOTES

The Illuminating Engineering Society has presented to the Library some eighty volumes relating to the gas industry, among which are many of decided interest. These had been presented to them by Dr. William Paul Gerhard, but the society, believing that the conveniences of all would be best served by collecting all engineering material together, has secured Dr. Gerhard's consent to this disposition of his gift.

Mr. Edward Wegmann has presented to the Library a bound set of the contract specifications issued by the Aqueduct Commissioners of New York City from 1885 to 1901, covering the contracts in connection with the Croton Aqueduct. The estimates and bids for the construction of the various parts of the work have been inserted in this set, adding much to its value for reference.

## BOOK REVIEWS

**Empirical Formulas**, by Theodore R. Running, Associate Professor of Mathematics, University of Michigan. John Wiley & Son, Inc., New York, 1917. Cloth, 6 x 9 in., 144 pp., 31 Figs. and 22 sets of reference curves, $1.40 net.

THIS is the nineteenth volume of the series of Mathematical Monographs edited by Mansfield Merriman and Robert S. Woodward. Although several books on mathematics devote one or more chapters to the derivation of empirical formulæ and there are a few very good magazine articles on the subject, this is the most complete treatise on the subject ever published and the first book worthy of the title.

The derivation of an empirical formula is the result of qualitative and quantitative mathematical analyses of certain data and the general methods are somewhat similar to those employed in qualitative and quantitative chemical analyses. The quality or form of the equation for a given set of data is found by testing with certain reagents such as logarithmic paper, tabulation of differences, graphs of quotients and products, etc., and the quantity or constants in the equation are found by substituting the coördinates of selected points by measurements from graphs, or from tabulated differences. A chemist may exercise all five of his senses in testing for the presence of various constituents in a chemical compound; but the engineer or mathematician is confined largely to his one sense of sight in observing the results of his reagents in determining the form of an equation that is best suited for the data under consideration.

There is a different test or reagent for each form of equation and the guide in using these is a set of reference curves, which are at times misleading. After the form of equation has been determined there should be no particular difficulty in determining the constants.

The subject-matter of the first five chapters of this book consists of discussions and applications of twenty-two tests or reagents based largely on the system of tabulated differences, which may be used to an advantage in many cases. These equations may be looked upon by the engineer as twenty-two tools that may be used in deriving equations that will satisfactorily represent the results expressed by data. It does seem that this number should be sufficient for such work, even though considerable difference of opinion is liable to be exercised in choosing such a collection. Many of the equations given by the author would be selected by most anyone familiar with the subject. Several of the equations given by him lead to rather complicated formulæ and should be avoided unless there is some exceptional reason for their adoption. Most any exponential formula is likely to be inconvenient or cumbersome to use, but fortunately the solutions of such may be readily performed by means of slide rules and charts.

Chapter V is devoted to the application of Fourier series to a number of ordinate schemes, which are applicable to periodic laws based on angular measurements such as wave analysis and certain theoretical phenomena. In Chapter VI is found a very good explanation of the application of the method of least squares to the derivation of empirical formulæ, in which the essentials are clearly and briefly given. Chapter VII deals with interpolation and differentiation of tabulated functions. It is of particular value in computations of precision in which a high degree of accuracy is desired. Chapter VIII gives some very practical work on numerical integration that should be useful to engineers.

The Appendix gives a very useful set of curves corresponding to each of the before mentioned twenty-two equations and is one of the most important features of the book.

Although the methods proposed by Prof. A. S. Langsdorf and Mr. Winslow H. Herschel are not pointed out as such, the principles involved in their methods are included in the author's system of tabular differences. The system adhered to by the author includes the principles of the calculus, although he uses rather simple algebraic equations in preference to differential equations and his demonstrations are very easily followed. The calculus is used in only two chapters. The matter in the other six chapters and appendix is of a very practical nature and may be comprehended without knowledge of the calculus as such.

More space could have been devoted to the use of logarithmic paper, even though this subject has been very well covered in other books. Brief discussions on dimensional consistency, when to apply certain tests, simplicity vs. accuracy and distinction between accuracy and precision, would not be out of place in such a book.

This is a practical book and should be particularly valuable to engineers engaged in research, design, time study, estimating costs, testing and any other work involving the use of tabular values derived from experimental or other observed data.

A. LEWIS JENKINS.

# ACCESSIONS TO THE LIBRARY

ARDOLT ENAMEL SIGN COMPANY. *New York City.* Catalogue, n. d.

DIE ACHATE. By R. Ed. Liesegang. *Dresden, 1915.* Purchase.

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